CIVIL ENGINEERING

FEBRUARY 1957

THE MAGAZINE OF ENGINEERED CONSTRUCTION

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

THREE-MILLION-DOLLAR RAMP-TYPE GARAGE ...R. O. GRIMES

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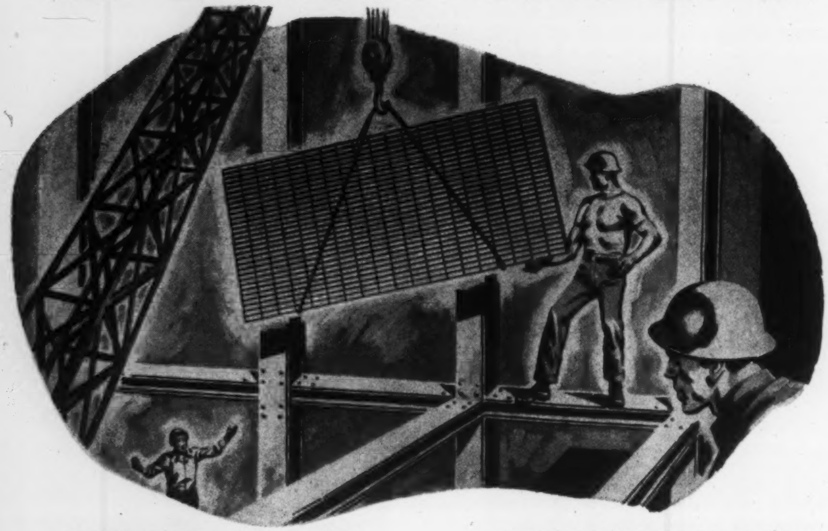
BUILDING?



? INDUSTRIAL PLANTS
? POWER HOUSES
? PUBLIC UTILITIES
? PUBLIC BUILDINGS
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CIVIL ENGINEERING

FEBRUARY 1957
VOL. 27 • NO. 2

THE MAGAZINE OF ENGINEERED CONSTRUCTION

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Printed in U.S.A. by Rumford Press.

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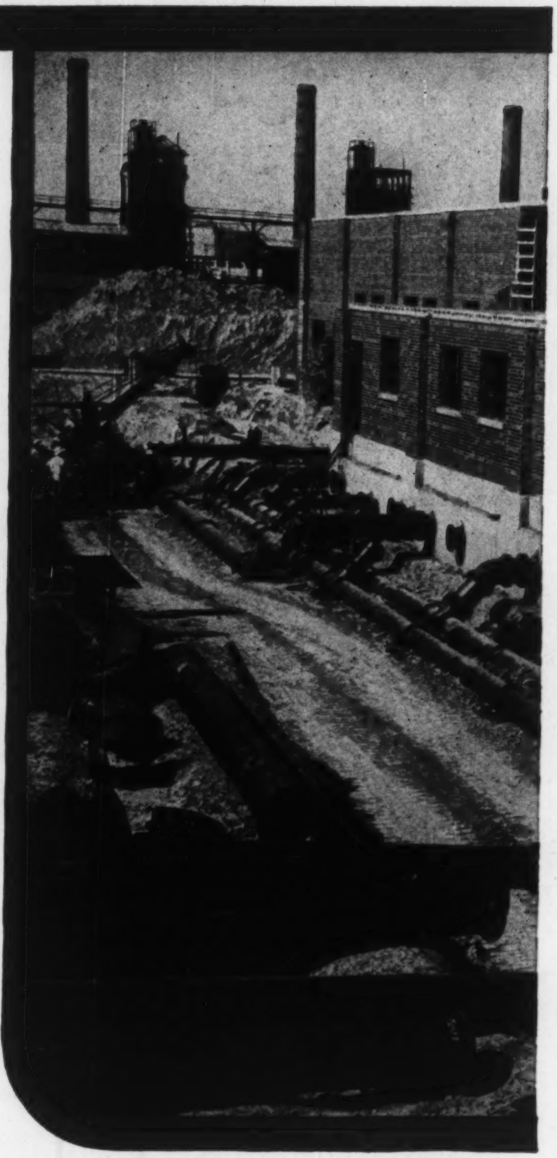

Robinson, Ill.—Mechanical Joint cast iron pipe being installed at Ohio Oil Company Refinery.

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International Falls, Minn.—Installation of flanged cast iron pipe and fittings in filter plant of Ontario Paper Co.

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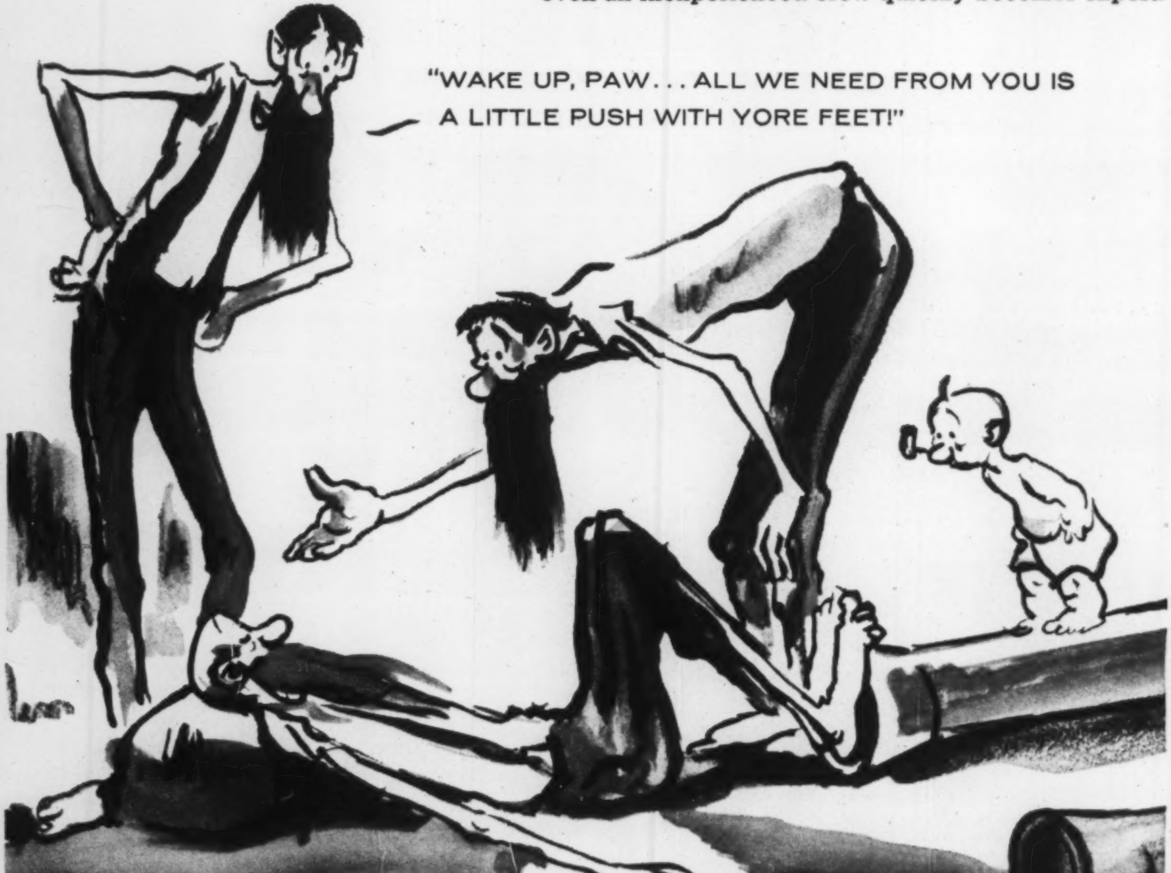

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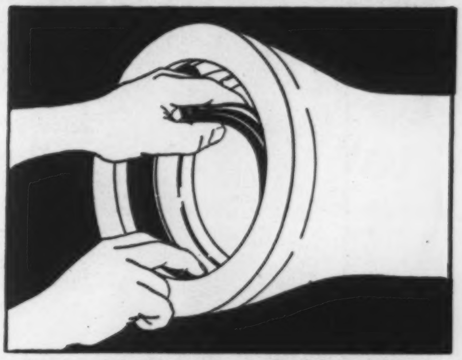
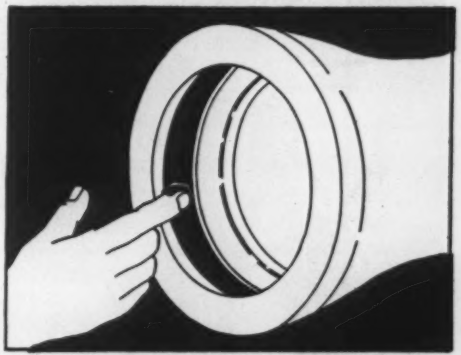
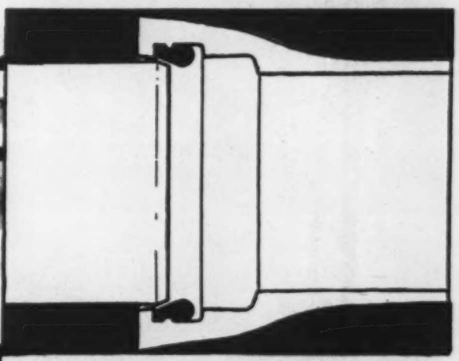


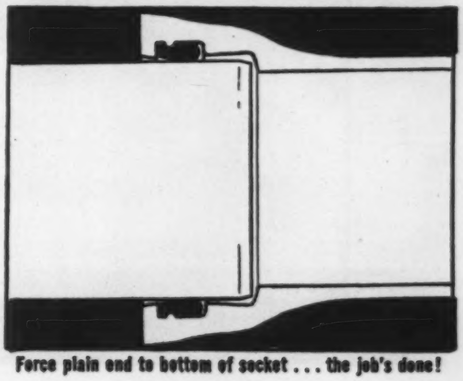
Insert gasket with groove over bead in gasket seat



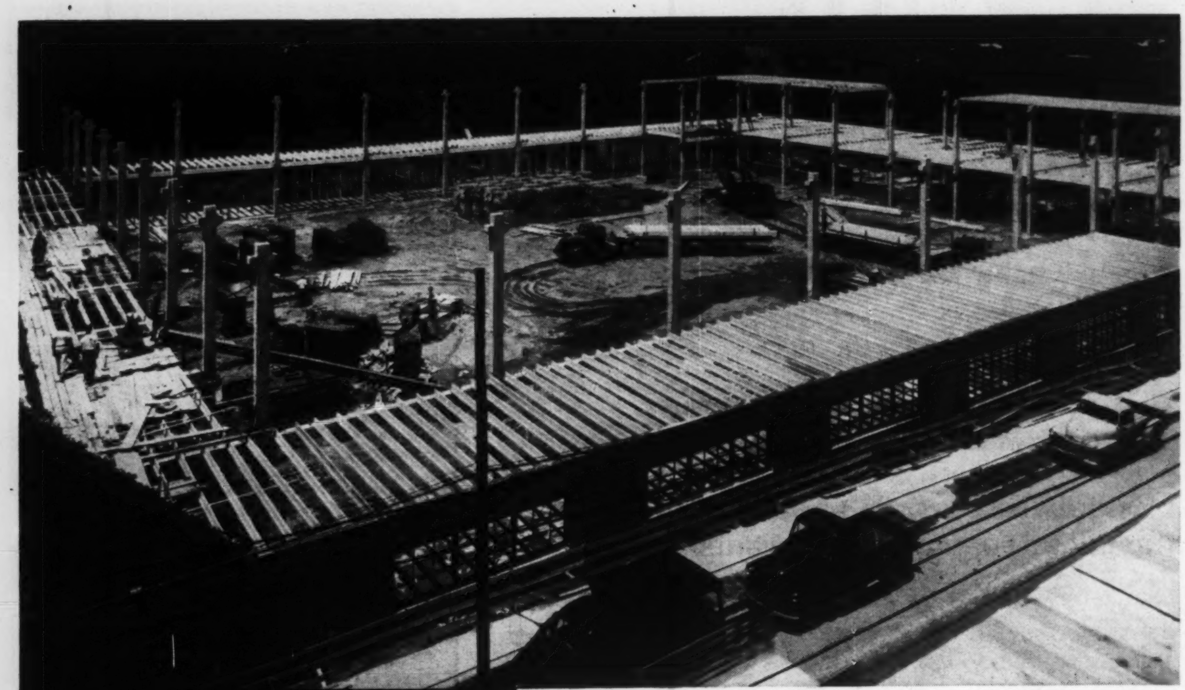
Wipe a film of special lubricant over inside of gasket



Insert plain end of pipe until it contacts gasket

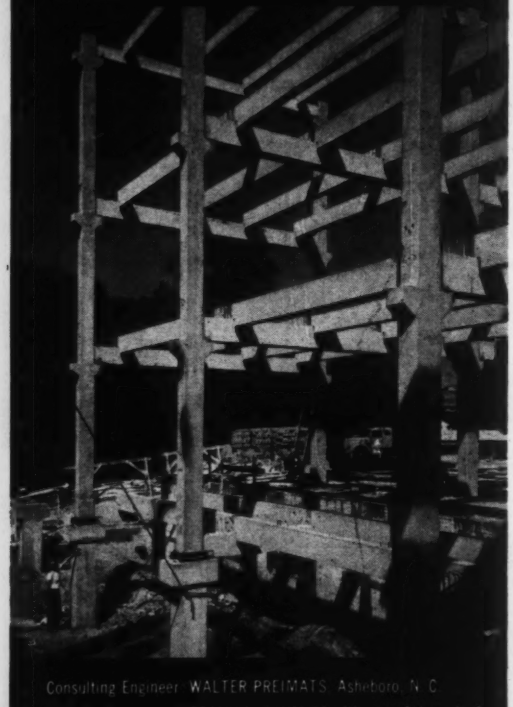


Force plain end to bottom of socket . . . the job's done!



Upper photo: Finishing plant is 196 feet by 296 feet and two stories high.

Lower photo: A portion of the manufacturing plant; 270 feet by 259 feet, which is two, three and four stories high.



Consulting Engineer: WALTER PREIMATS, Asheboro, N. C.

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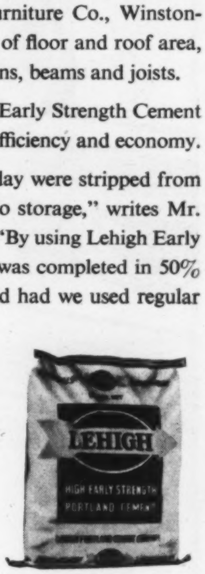
This is typical of the advantages of Lehigh Early Strength Cement in modern concrete construction.



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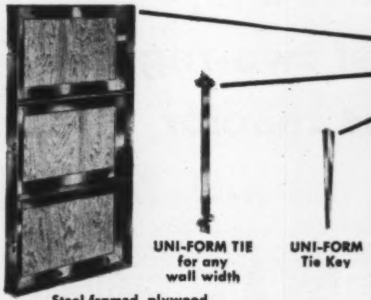

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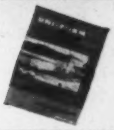
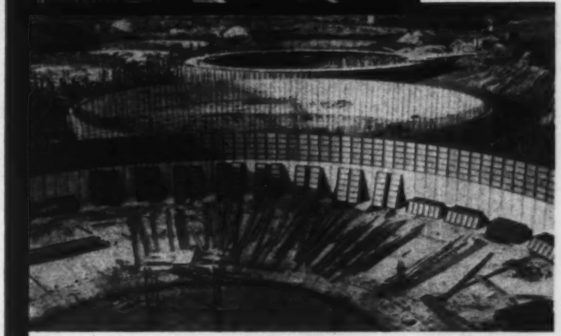


Sewage Treatment Plant "Y" Walls

Slabs



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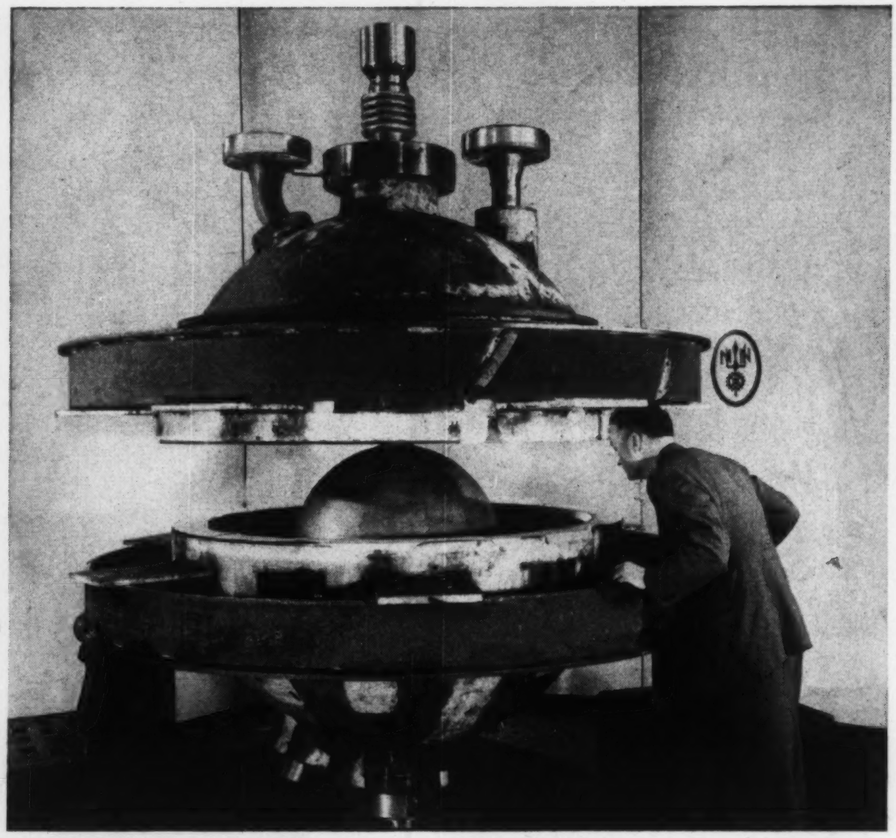

Assembly of zircaloy-2 core tank and pressure vessel for Homogeneous Reactor Experiment No. 2 (HRE-2). The HRE-2 is a 5,000 KW plant designed for AEC by Union Carbide Nuclear Company. Newport News manufactured the 32" I.D. core vessel from 5/16" zircaloy-2, which involved the development of new welding techniques. The pressure vessel of Type 347 stainless clad steel is 4.4" thick, with an inner diameter of 60". Newport News designed the expansion joint between inner and outer vessels, and also produced the unusual coil-cooled blast shield for the unit.

Zircaloy-2 vessel produced by Newport News...for first two-region breeding homogeneous reactor

Never before had a pressure vessel been constructed from zircaloy-2.

Extremely active chemically, particularly at elevated temperatures, this alloy challenged fabrication. Unshielded, heated zircaloy absorbs atmospheric gases in quantities that render its corrosion and physical properties unsatisfactory. Newport News, however, achieved consistent, satisfactory welds by use of inert gas and novel, plant-developed shielding.

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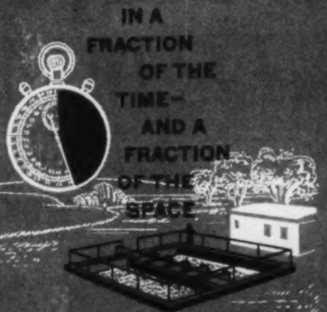

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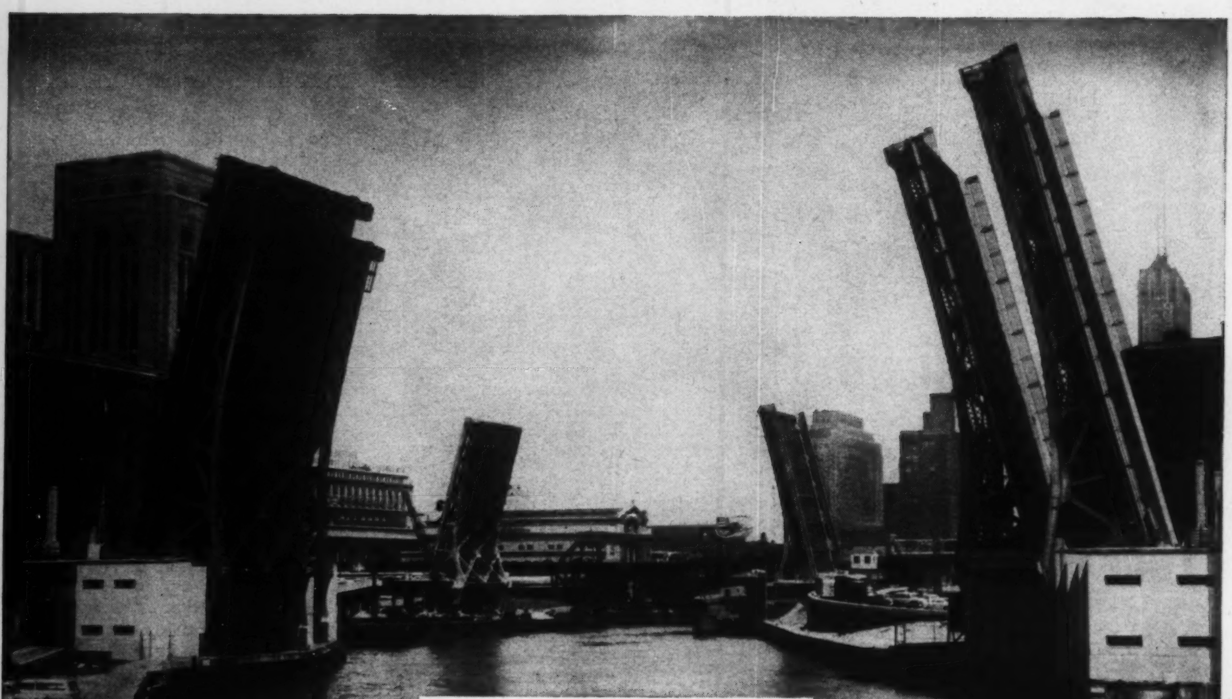

CONGRESS ST. BRIDGE

VAN BUREN ST. BRIDGE

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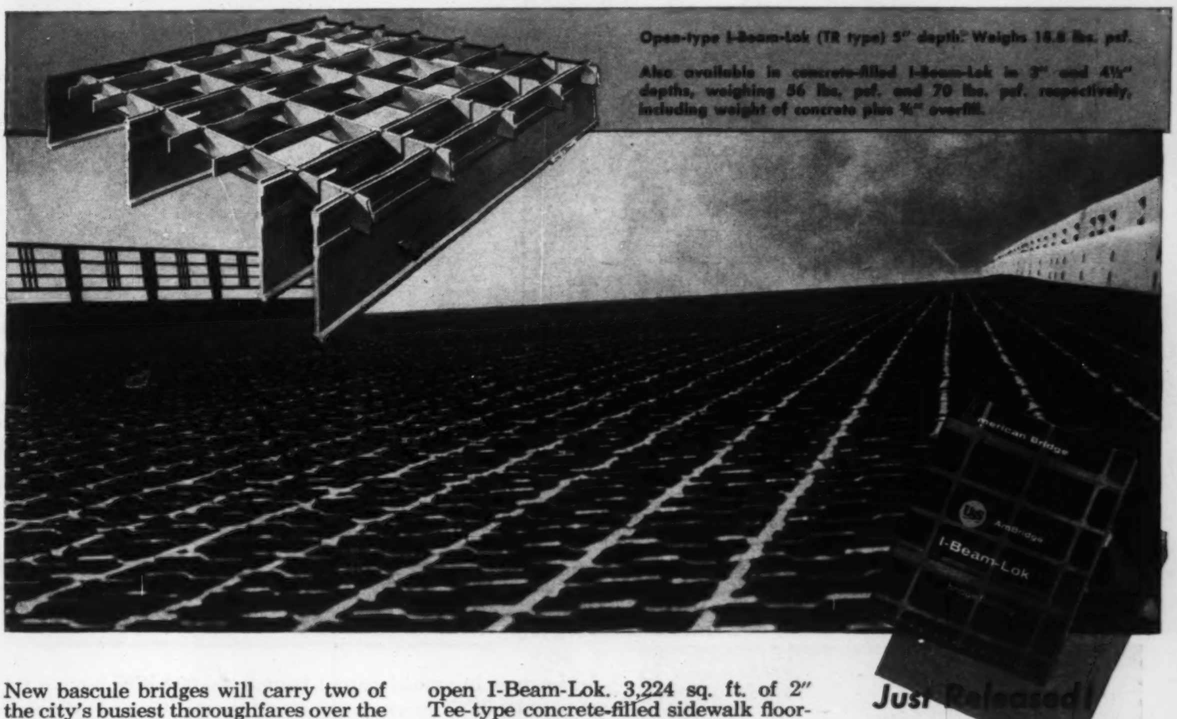
City of Chicago Department of Public Works
George DeMent, Commissioner.
Bureau of Engineering, Division of Bridges
and Viaducts,
Stephen J. Michuda, Chief Bridge Engineer.

GENERAL CONTRACTOR
Overland Construction Company.

# of USS AMBRIDGE I-BEAM-LOK



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THE CONGRESS STREET BRIDGE, in the foreground of the picture on the opposite page, consists of two double-leaf, deck truss, trunnion bascule bridges. They are parallel but staggered 31′-7⁵⁄₁₆″. Each is 244′-8⅜″ long, c-c of trunnions, and has a 43′ roadway and a 9′-8″ sidewalk. 19,033 sq. ft. of 5″ open USS AmBridge I-Beam-Lok flooring was used for the roadways, and 3,846 sq. ft. of 2″ Tee-type concrete-filled sidewalk flooring for the walkways.

THE VAN BUREN STREET BRIDGE, in the background of the picture, is a double-leaf, trunnion bascule bridge, 210′-4″ long, c-c of trunnions. It has a 44′ roadway and two 8′-3″ sidewalks. The roadway is floored with 8,475 sq. ft. of 5″ open I-Beam-Lok. 3,224 sq. ft. of 2″ Tee-type concrete-filled sidewalk flooring was used for the walkways.

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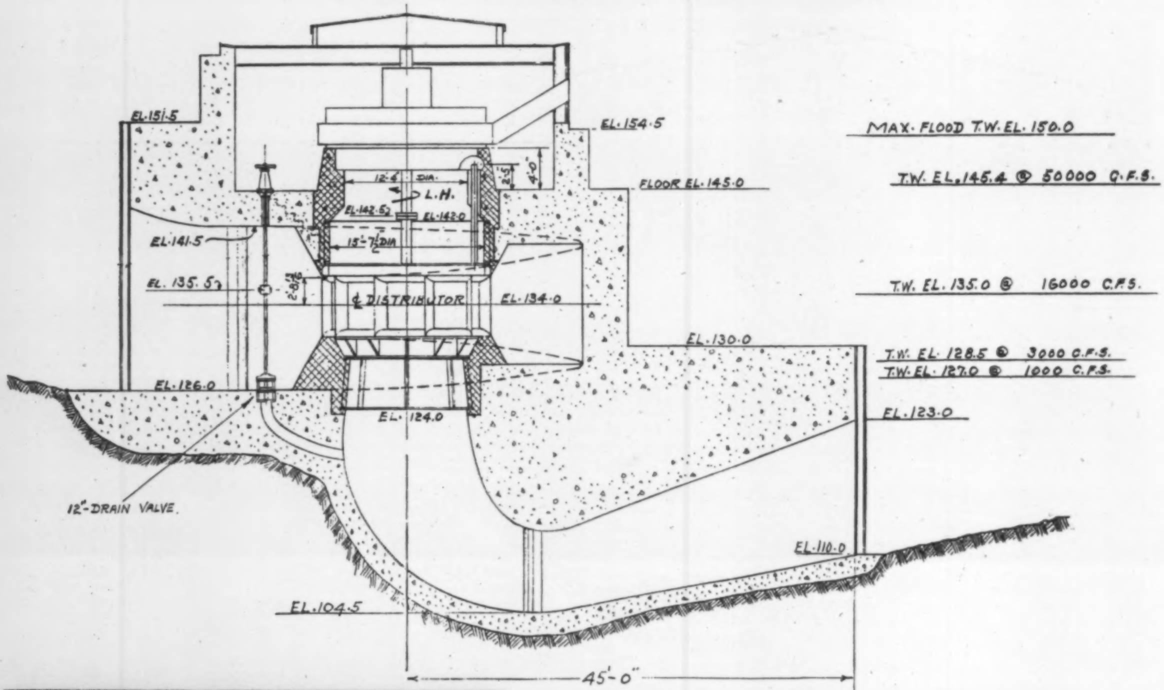
USS AMBRIDGE I-BEAM-LOK BRIDGE FLOORING

UNITED STATES STEEL

at the Central Maine Power Company's Bar Mills Station

Two Leffel Turbines Help Boost Power Output By 150%


EL.151.5
EL.154.5
MAX. FLOOD T.W. EL. 150.0
12'-6" DIA.
L.H.
2'-5"
4'-0"
FLOOR EL. 145.0
T.W. EL. 145.4 @ 50000 C.F.S.
EL.142.62
EL.142.0
EL.141.5
15'-7½" DIA
EL. 135.5
2'-8½"
℄ DISTRIBUTOR
EL.134.0
T.W. EL. 135.0 @ 16000 C.F.S.
EL.130.0
T.W. EL. 128.5 @ 3000 C.F.S.
T.W. EL. 127.0 @ 1000 C.F.S.
EL.126.0
EL.124.0
EL.123.0
12"-DRAIN VALVE.
EL.110.0
EL.104.5
45'-0"

An increase in annual output from 8,500,000 KW hours to 21,000,000 KW hours is expected by the Central Maine Power Company as a result of the recently completed rebuilding of their Bar Mills Hydroelectric Station. Two Leffel turbines—replacing four smaller turbines installed in 1919—play a major role in the Bar Mills redevelopment.

Each of the turbines is rated to develop 3,000 HP at 120 RPM under a twenty foot net effective head. The turbines, of the fixed-blade propeller type, are installed in concrete spiral casings and mounted on curved concrete elbow draft tubes.

The top view at the left shows the completed power plant and dam; the bottom view shows the installation of the turbine stay ring and pit liner in the concrete spiral casing.

Here and throughout the world, Leffel turbines are economically and efficiently harnessing water power. Before you plan any future turbine installation, get the facts on efficient, reliable Leffel turbines tailored to meet all your hydroelectric power requirements. Write today for complete information.

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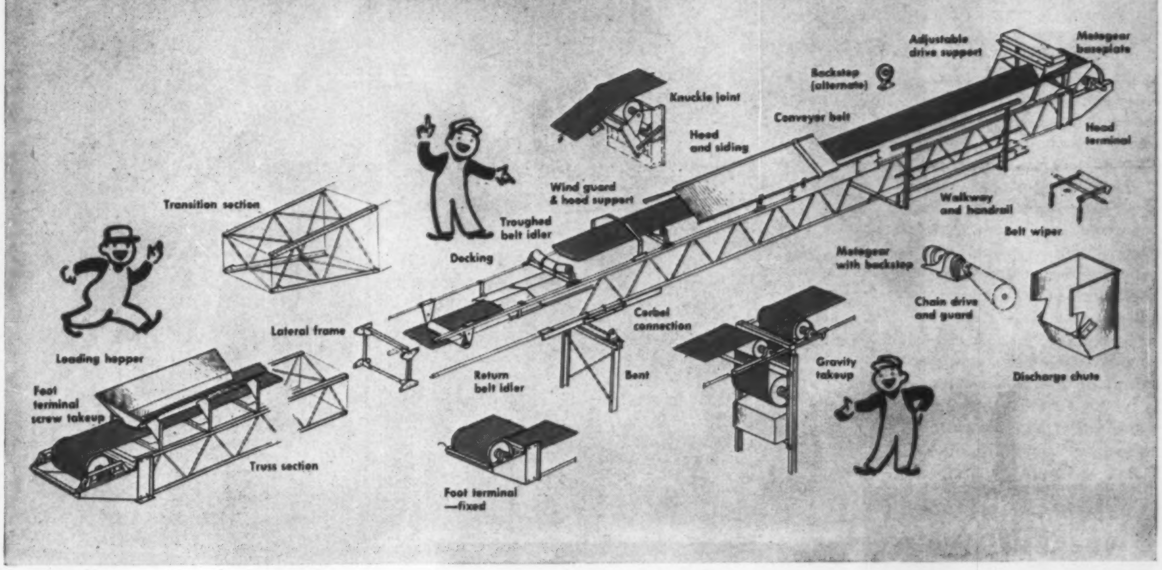
THE JAMES LEFFEL & CO.

DEPARTMENT C • SPRINGFIELD, OHIO, U. S. A.

MORE EFFICIENT HYDRAULIC POWER FOR 95 YEARS

THESE STANDARD COMPONENTS ARE ALL AVAILABLE TO MEET YOUR INDIVIDUAL REQUIREMENTS


Adjustable drive support
Motogear baseplate
Backstop (alternate)
Knuckle joint
Conveyor belt
Hood and siding
Head terminal
Wind guard & hood support
Transition section
Troughed belt idler
Walkway and handrail
Belt wiper
Decking
Motogear with backstop
Chain drive and guard
Corbel connection
Lateral frame
Loading hopper
Return belt idler
Bent
Gravity takeup
Discharge chute
Foot terminal screw takeup
Truss section
Foot terminal —fixed

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Your Link-Belt representative will help you select the best combination of PRE-BILT sectional belt conveyor components.

Standard 18, 24, 30 and 36-inch widths need no special engineering

Here's an economical, standardized belt conveyor "package" . . . ready to meet the majority of belt conveyor needs and perform dependably for years and years. It combines standard Link-Belt products with sectional truss frames and steel supporting bents.

Book 2579 has further data on Link-Belt PRE-BILT conveyors . . . with drives up to 40 hp and 24 and 42-inch truss depths. Write today, or ask for a copy at your nearest Link-Belt office.

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prompt quotations

He will prepare a comprehensive and accurate estimate of requirements for installations that permit "on-the-ground" survey.

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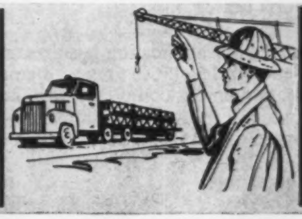
Parts are standardized, interchangeable, all available from one supplier. Link-Belt representative can furnish all data.



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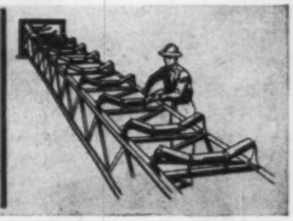
PRE-BILT conveyors are built at nine strategic locations throughout the country and are shipped from the plant nearest you.



fast installation

Can be readily handled by your own erectors in most cases. Link-Belt can also furnish complete erection service and supervision.

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Ten hydraulically operated SMS-Rotovalves here range in size from 18″ to 30″.

Engineers: Greeley & Hansen, Chicago.

For the City of Niagara Falls, N.Y. . . .

SMS-ROTOVALVES SAFEGUARD HIGH AND LOW SERVICE PUMPS

SMS-Rotovalves were specified to safeguard service pumps in the City of Niagara Falls' new pumping station. Greater initial shut-off and positive control of closing time made them a logical choice to minimize water hammer in pump start-ups and shutdowns. Because SMS-Rotovalves have less pressure loss with a full line opening than other valve types, they save pumping power.

In addition to the SMS-Rotovalves, SMS Babbit-Seated Butterfly Valves meet the rugged, high service header requirements of fast, positive closure. At the adjacent filtration plant, 76 R-S Rubber-Seated Butterfly Valves were specified to give drop-tite closure, unusual economy of layout space and cut initial construction costs.

Whatever your application requirements, SMS has the experience and facilities to meet them. For additional information on our complete line of cone, ball and butterfly valve, see our local representative or write the S. Morgan Smith Company, York, Pennsylvania.

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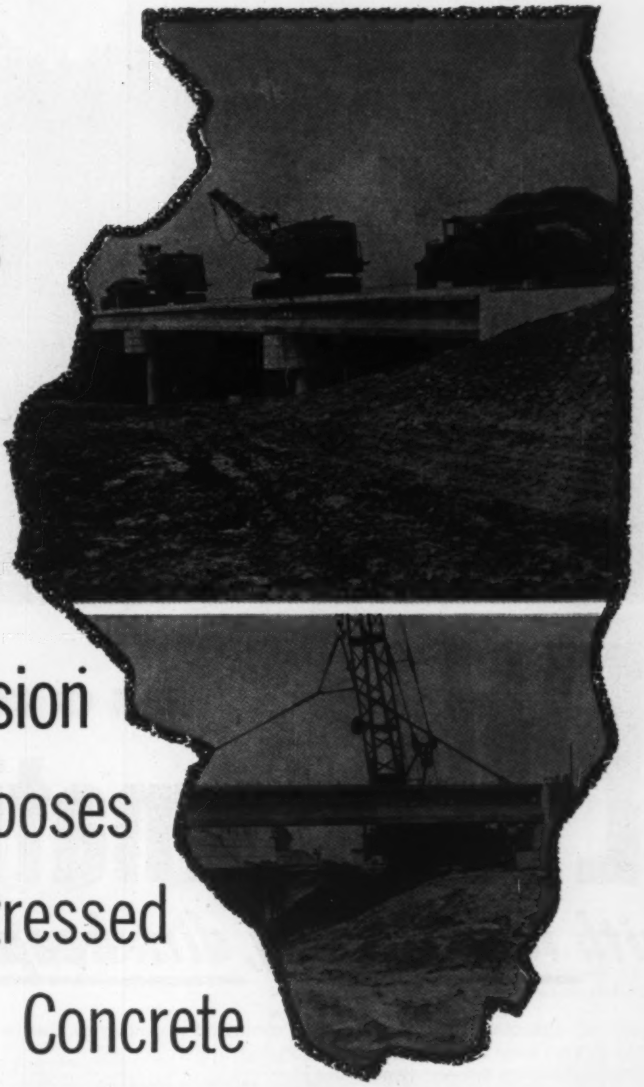
Controllable-Pitch Ship Propellers

AFFILIATE COMPANY: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

Illinois State Toll Highway Commission chooses Prestressed Concrete for 212 Bridges!



Overload test of Beverly Road Bridge. Four spans, continuous under live loads, center to center of piers measured along center line of girders are: 42'-10"; 70'-5"; 70'-5"; 42'-10". Skew is 20°. Precast prestressed I-section girders—without intermediate diaphragms—are 48" deep and placed 7'-6" center to center. Precast, pretensioned 2½" deck slabs were placed on the girders with a 5" slab poured on top. Intermediate piers are 36" diameter prestressed hollow piles with 4" walls.

Girders and 2½" slabs for the test bridge made by Prestressed Concrete Structures of Frankfort, Illinois, using Roebling 7-wire stress-relieved strands.

Placing 42'-10" span girder on Beverly Road Bridge.

Write for your free copy of Roebling's 16-page booklet, "Tensioning Materials for Prestressed Concrete."

This choice is the result of exhaustive research together with testing of the continuous type of prestressed structure which was adopted. Initial cost, efficiency, delivery and maintenance were factors that governed the final choice...and each was more successfully met by prestressed concrete than any other type of bridge.

The initial cost of the prestressed concrete design is appreciably lower than with existing alternate designs and materials.

Dynamic tests on the Beverly Road Bridge proved conclusively that the prestressed method means less vibration and deflection under high-speed traffic—two factors which are cause for increasing complaints on other types of bridges.

The faster delivery (first bridge will be delivered about 5 months after bidding) will reduce cost of other construction operations because these bridges can be used for access to uncompleted highway sections. Highway can begin collecting tolls on completed sections sooner.

Prestressed concrete requires no painting—repair and maintenance costs are less. The 212 bridges in the Northern Illinois Toll Highway will have a total of 6300 prestressed girders varying in length from 40 to 90 ft. Bridges are designed by Joseph K. Knoerle and Associates, Inc., Baltimore, Maryland.

For data on tensioning elements, casting yards, fabrication methods, design procedures and other prestressed concrete information, write Construction Materials Division, John A. Roebling's Sons Corporation. Trenton 2, New Jersey.

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Two NEW BIG BONUS International

with fast-loading, dirt-heaping, clean-

Now...all the advantages of famous International scraper design are available in two new towed scrapers —to turn big International crawler power and traction into *big-bonus yardage.* The new 20 cu yd heaped 4S-85 is matched in weight and capacity with the giant TD-24 to pile up profits on the fill. The 14-yard heaped 4S-55 is a cycle-speeder behind TD-18 heavy-duty pull!

Turn on International crawler power with one of these new scrapers—and watch the dirt boil in freely—compact itself into corners—build up an extra-yardage heap. These new scrapers have *flush-smooth* bowl interiors for *flow-easy* dirt action. You've never seen such fast, easy, big scraper loading! And outside-mounted apron arms insure super-speedy, load-trapping apron action!

Ground-hugging profile and low draft arm connections give these new International scrapers an amazing new load-heaping line of draft—plus greatly increased *all-speed* stability for rough-terrain hauling! Roll-out ejection assures fast dumping, and positive discharge of wet, sticky material!

Study the extra yard-getting features of these new big-capacity scrapers from the new balanced, easy-hitch tongue to the big-target push-block. Ask your International Construction Equipment Distributor for a demonstration.

INTERNATIONAL HARVESTER

INTERNATIONAL®
Construction Equipment

YARDAGE

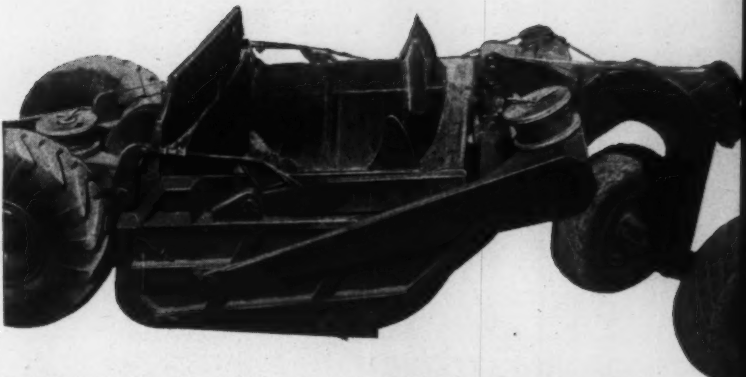
Scrapers

dumping design!

BRIEF SPECIFICATIONS:

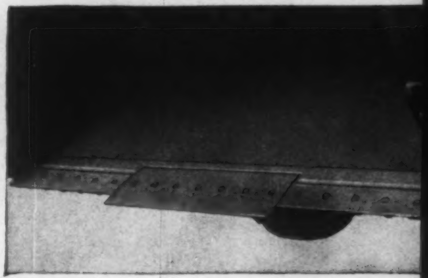
Model	Recommended Tractor Size	Capacity		Capacity (with Sideboards)		Shipping Weight (Approx.)
		Struck	Heaped	Struck	Heaped	
4S85	TD-24	16	20	19	22	37,200
4S55	TD-18	10	14	12	15	26,360

Controlled, even spreading is accomplished by positive, power-saving roll-out ejection. High-lift apron, opened by ejector, eliminates excessive sheave travel and complicated reeving. All four axles of these new scrapers are individually replaceable, to minimize downtime, reduce repair expense! Below, the model "55" and TD-18 on the fill.

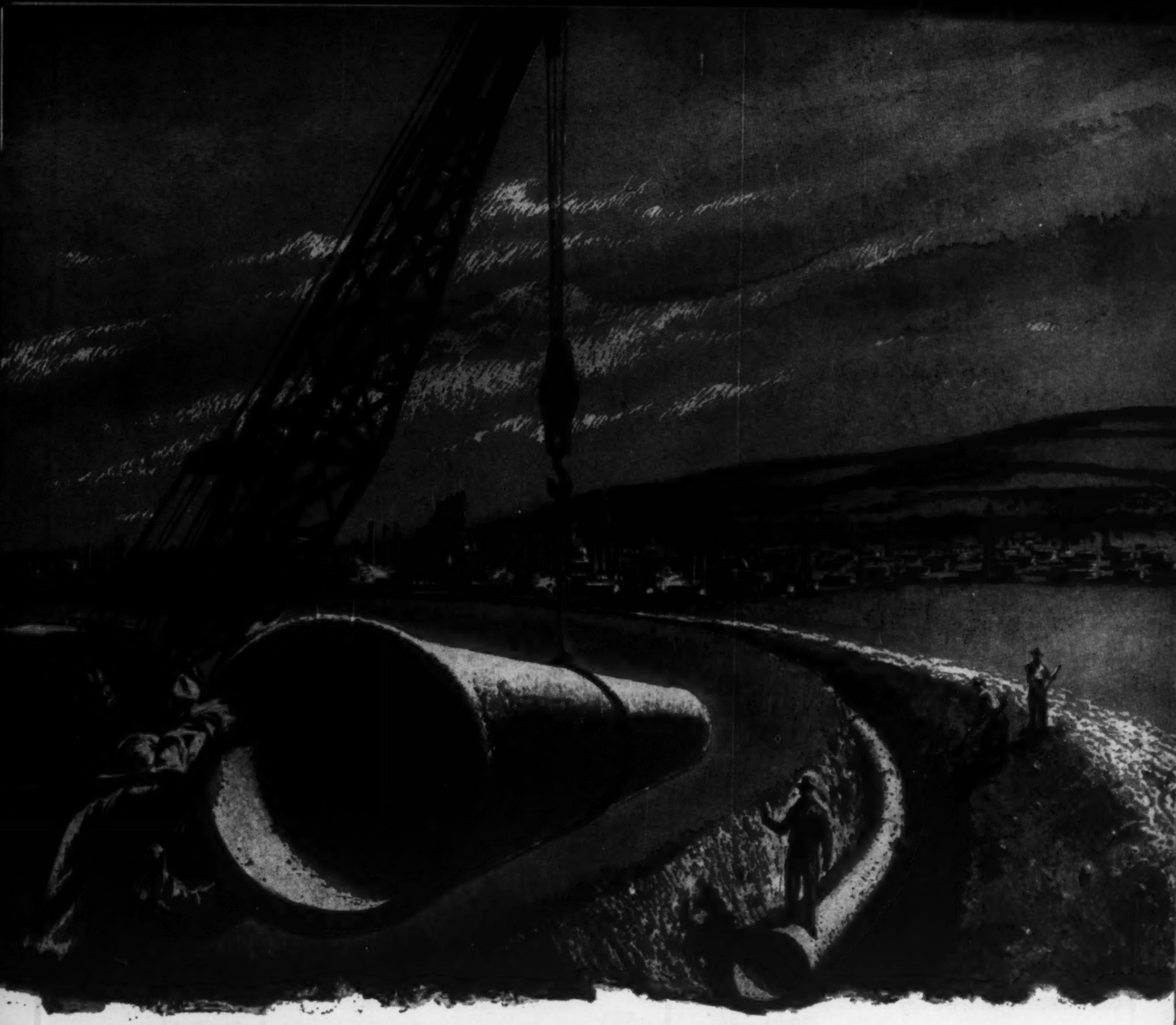


New fast-loading bowl design is obtained with a low rear apron contour that gives positive, built-in dirt-boiling action under all loading conditions. Even the wearbars protecting tilting floor hinge are blended into cutting edge bed—to insure smooth dirt flow!

New cutting edge, where boiling action begins, consists of three equal-length, completely *interchangeable* and *reversible* sections. This design simplifies your parts inventory! And the cutting edge depth can be quickly changed to three different positions to match soil conditions and increase loading efficiency!



Exclusive power-saving double ball bearing sheaves maintain correct sheave alignment—provide increased cable and sheave life in these new scrapers. Below, it's the new 20-yard model "85" International scraper being self-loaded by a TD-24 crawler.



TO MEET UNPRECEDENTED DEMANDS FROM INDUSTRY...

MAIN WATER SUPPLY LINES BY AMERICAN PIPE AND CONSTRUCTION CO.

The challenge of furnishing water to Rancho San Pedro Industrial Center, one of the nation's fastest growing planned industrial areas, located between Los Angeles and Long Beach, forced privately-owned Dominguez Water Corporation to plan extensive additional facilities for its water system. Since 1951 ideal conditions have attracted more than 50 important industries and 10,000 new homes to the area the company serves. Alert Dominguez Water Company officials anticipated increased industrial and domestic needs and launched an expansion program keeping pace with unprecedented demands.

For example, during the past 24 months, Dominguez has ordered American Concrete Cylinder Pipe for 11 separate installations, predominantly main water transmission lines. The company also tapped the Los Angeles Metropolitan Water District's supply lines for a supplemental source, using 42" American Concrete Cylinder Pipe. This augmented a system formerly supplied by wells and reservoirs alone.

T. V. Tallon, Chief Engineer and General Manager of Dominguez Water Corporation, has expressed his pleasure with the cooperation and service of American Pipe and Construction Co., "During our present expansion program, American Pipe has consistently met our delivery deadlines – some of them urgent – yet held to the same high manufacturing standards as first attracted American to our attention."

American Pipe makes available 50 years of experience and extensive production facilities to help solve any water supply problem. There is a type of American Pipe to meet any requirement. Write or phone for information.

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4635 Firestone Blvd., South Gate, Calif. Phone LOrain 4-2511

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District sales representatives:
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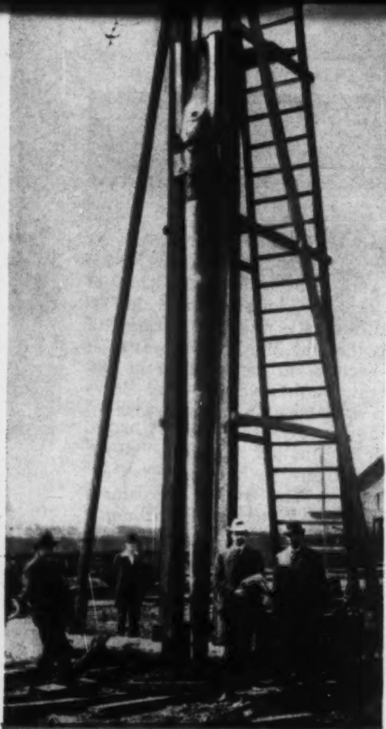
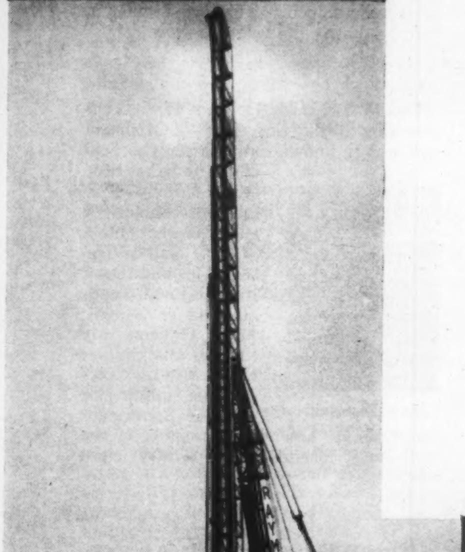
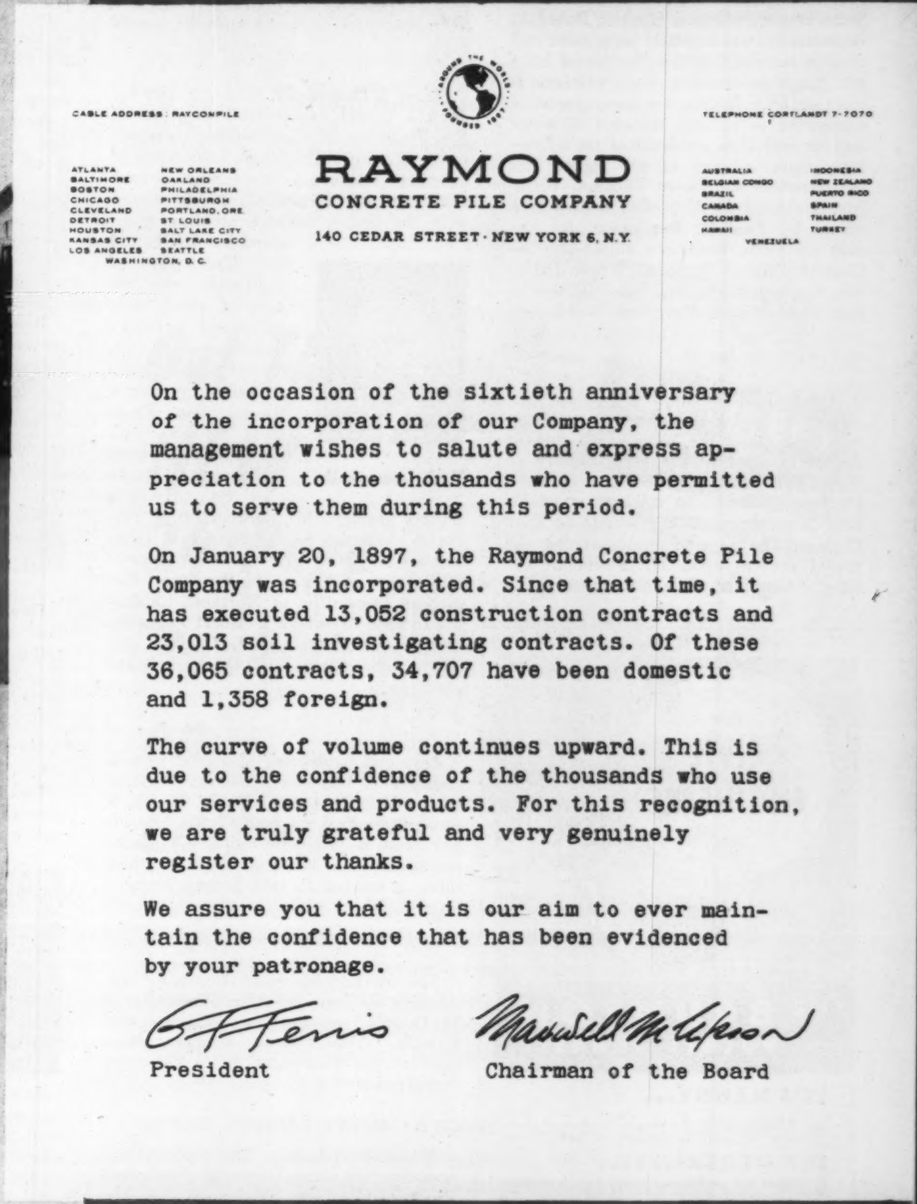


One of Raymond's earliest pile drivers at work in Chicago at the turn of the century.

On the job in Detroit, Michigan in 1956 with one of Raymond's newest and largest drivers—a 186' rig.





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On the occasion of the sixtieth anniversary of the incorporation of our Company, the management wishes to salute and express appreciation to the thousands who have permitted us to serve them during this period.

On January 20, 1897, the Raymond Concrete Pile Company was incorporated. Since that time, it has executed 13,052 construction contracts and 23,013 soil investigating contracts. Of these 36,065 contracts, 34,707 have been domestic and 1,358 foreign.

The curve of volume continues upward. This is due to the confidence of the thousands who use our services and products. For this recognition, we are truly grateful and very genuinely register our thanks.

We assure you that it is our aim to ever maintain the confidence that has been evidenced by your patronage.

G F Ferris
President

Maxwell McPherson
Chairman of the Board

RAYMOND

CONCRETE PILE COMPANY

140 Cedar Street, New York 6, N. Y.

FOUNDATIONS FOR THE STRUCTURES OF AMERICA
COMPLETE CONSTRUCTION SERVICES ABROAD

NEWS OF ENGINEERS

Vinton W. Bacon, for the past six years executive officer of the California State Water Pollution Control Board at Sacramento, was recently appointed executive secretary of the Northwest Pulp and Paper Association. The organization has just been formed for the purpose of sponsoring permanent research in water and air pollution problems of the important paper industry of the region. His headquarters will be in Tacoma, Wash. Mr. Bacon will be succeeded as executive officer by **Paul R. Bonderson,** for the past six years executive officer for the Central Coastal Regional Water Pollution Control Board, with headquarters at San Luis Obispo. **Raymond Walsh** will take Mr. Bonderson's place as executive officer for the Board.

David B. Steinman, New York City consultant and famous bridge engineer, was honored at the recent 76th Annual Alumni Dinner of the City College of New York and awarded the college's Centennial Medal in celebration of his 50th anniversary as a graduate of City College. The citation accompanying the medal confers upon Dr. Steinman the title "Alumnus Extraordinarius." Dr. Steinman's largest current engineering project is the Mackinac Bridge in Michigan.

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ENGINEERS

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Henry J. Degenkolb, chief engineer for John J. Gould, construction engineer of San Francisco, has been elected president of the Structural Engineers Association of Northern California. A specialist in timber design, Mr. Degenkolb was associated with the timber research program sponsored by ASCE and the University of California, the results of which have influenced present building code requirements and construction practices. Recent San Francisco projects with which he has been connected include the St. Mary's Square Garage. Mr. Degenkolb is currently chairman of the Structural Division's Committee on Timber Structures. Other new officers in the Structural Engineers Association of Northern California include Members **J. Albert Paquette,** vice-president; **Donald M. Teixeira,** secretary; and **Samuel H. Clark,** assistant secretary.

H. J. Degenkolb

Raymond Archibald, formerly division engineer of the San Francisco Division of the U.S. Bureau of Public Roads, is now manager of the new West Coast office of J. E. Greiner Company, consulting engineers of Baltimore, Md. The new office is located at 1411 Fourth Avenue, Seattle, Wash.

The Bethlehem Steel Company announces the retirement, on January 1, of **H. O. Hill,** assistant chief engineer, and **Camillo Weiss,** senior designer. Both were in the Fabricated Steel Construction Division.

Frank G. Louthan, Jr., is new vice-president of the Concrete Pipe and Products Company, Richmond, Va. Mr. Louthan joined the organization in 1950 after a period with the Crenshaw Equipment Company there. He is secretary of the Virginia Section of the Society.

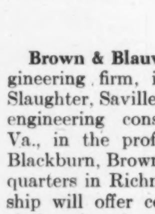
W. A. Bugge, director of highways for the Washington State Highway Commission at Olympia, was elected president of the American Association of State Highway Officials at that organization's recent annual meeting at Atlantic City, N. J.

Bernard D. Murphy has received the Royal Iraqi Flood Relief Medal for his "great work in overcoming the dangers" of the record-breaking floods on the Tigris and Euphrates rivers in the spring of 1954. At the time Mr. Murphy was chief design engineer in the Ministry of Development, Iraqi Government, at Baghdad, on assignment from his post as regional design engineer for the U.S. Bureau of Reclamation at Billings, Mont. Since last August he has been chief engineer of the Pennsylvania Department of Forests and Waters at Harrisburg.

Brown & Blauvelt, New York civil engineering firm, is now associated with Slaughter, Saville & Blackburn, industrial engineering consultants of Richmond, Va., in the professional partnership of Blackburn, Brown & Blauvelt, with headquarters in Richmond. The new partnership will offer combined industrial and civil engineering services. Brown & Blauvelt has specialized in superhighway and toll road work.

David K. Todd, assistant professor of civil engineering at the University of California, Berkeley, has been awarded a National Science Foundation post-doctoral fellowship for hydrologic studies in Europe during the calendar year 1957.

Leo M. Legatski, professor of civil engineering at the University of Michigan and widely known authority in the field of concrete, has been appointed vice-president of engineering and research and a director of the Elastizell Corporation of America, with headquarters at Alpena, Mich. The company controls distribution of Elastizell, a process for making a versatile lightweight concrete. He has been a member of the University of Michigan faculty since 1943.



Leo Legatski

Harry P. Burden will retire in September from the faculty of the Tufts University College of Engineering. He has been dean of the college since 1936.

Frederick T. Thayer, of the Thayer Construction Co., Memphis, Tenn., has been installed as new president of the Builders Exchange, central organization of the construction industry in Memphis.

Everett B. Mansur, chairman of the San Gabriel (Calif.) City Planning Commission and planning consultant for many different city and county planning commissions, was elected president for 1957 of the Southern California Planning Congress at the organization's recent annual meeting in Pasadena. The Congress, which consists of several hundred public officials and planners, has been active in stimulating better city and county planning for over thirty years.

James A. Lindsey, Jr., for the past three years president of the Lindsey Engineering Company with headquarters at Excelsior, Minn., and **Archie N. Carter,** for the past nine years manager of the highway contractors' division in the Washington, D. C., national office of the Associated General Contractors, are establishing the new firm of Lindsey, Carter & Associates, Inc., Consulting Engineers and Land Surveyors. Headquarters of the new company will be at Tonka Terrace Shopping Center, Excelsior. The firm will specialize in the planning and design of highways, drainage, water supply, sewerage and other municipal facilities, plus land surveying.

A. N. Carter

J. A. Lindsey

James R. Carr was recently appointed zoning engineer of the Michigan Department of Aeronautics at Lansing, Mich. Until lately Mr. Carr was in the engineering and architectural section of the Department of Conservation.

C. H. Chorpening, Major General, Army Corps of Engineers (retired), is now connected with Herbert Voelcker and Associates under the new firm name of Herbert Voelcker, C. H. Chorpening and Associates. The reorganized firm offers an architectural and engineering service for public buildings and public works, and has offices in Houston, Tex., and Centreville, Md.

Alexander H. Kenigsberg has retired from the Corps of Engineers, Nashville District, after twenty years of service as design engineer on various structures for flood control, navigation and power projects. After an extended tour of Europe, which will include inspection of several engineering projects, Mr. Kenigsberg is planning to resume the practice of civil and structural engineering. He is the author of several current ASCE Technical Publications.

Herman Bomze is now project manager for the New York City consulting firm of Frederic R. Harris, Inc. He was formerly structural designer for the Foster Wheeler Corp., of the same city.

Louis R. Hovater, Jr., has accepted the position of assistant chief engineer of the Globe Engineering Co., Long Beach, Calif., sales and installation contractors for Panelcraft reinforced molded asphalt linings for reservoirs, canals, and ditches. Mr. Hovater was formerly area engineer for the Asphalt Institute at Los Angeles.

Jewell T. Wood has been admitted to partnership in the consulting engineering firm of Cornett, Wood and Associates, with headquarters at Tulsa, Okla. Mr. Wood was previously designer for the Refinery Engineering Co., of Tulsa.

(Continued on page 26)

Get This NEW 24-Page Booklet on Carpullers!

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It shows at a glance, how to compute the cable tension per thousand pounds of load, at level or on various inclines. It tells how much to allow for weight of car, curvature of track, condition of track and low temperature conditions. It suggests the proper type of rope or cable for different jobs, and gives a table showing the working strength of each, according to diameter.

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MAIN OFFICE AND WORKS—SUPERIOR, WISCONSIN
NEW YORK OFFICE—7 Dey St., New York 7, N. Y.

News of Engineers

(*Continued from page 25*)

C. C. Whittelsey has been elected president of Ford, Bacon & Davis, engineers-constructors of New York, and its wholly owned subsidiaries, the Ford, Bacon & Davis Construction Corp. and Ford, Bacon & Davis, Canada, Ltd. Mr. Whittelsey was formerly executive vice-president. Connected with the firm since 1926, he has been in charge of the engineering and construction of many of its important projects, including petroleum products pipeline systems and the country's first, and one of its largest, plants for producing synthetic rubber.

R. J. Lyman has resigned as chief of the Military Branch, Engineering Division, Albuquerque District, Corps of Engineers, after fifteen years in a supervisory design capacity to accept the position of special projects engineer with the Atlas Building Products Co., El Paso, Tex. During the war Mr. Lyman served as an engineer officer in construction battalions and in the Manila, P.I., Engineer District.

David W. Griffiths

David W. Griffiths, Colonel, U. S. Army (retired), has joined the Harza Engineering Co., Chicago, and assumed an assignment in Iraq as resident engineer for the Derbendi Khan Dam, a $45,000,000 multiple-purpose structure under construction for the Government of Iraq. Colonel Griffiths retired in 1950 after 31 years of service with the Corps of Engineers, which included assignments most recently as district engineer at Galveston, Tex., and Athens, Greece.

Clarence N. Crocker, who retired on July 1 as state highway bridge engineer of Georgia, is now associated with J. E. Greiner & Associates, engineers and architects of Albany, Ga.

Henry T. Lofft, project manager for the Tennessee Valley Authority on construction of the Kingston Steam Plant, has been named chief construction engineer of the TVA. In his new post he will have engineering supervision of all TVA construction projects. He will succeed **George K. Leonard,** who moved up to chief engineer of the TVA when **Clarence E. Blee** retired from that post (January issue, page 26). Mr. Lofft has been with the TVA since 1935.

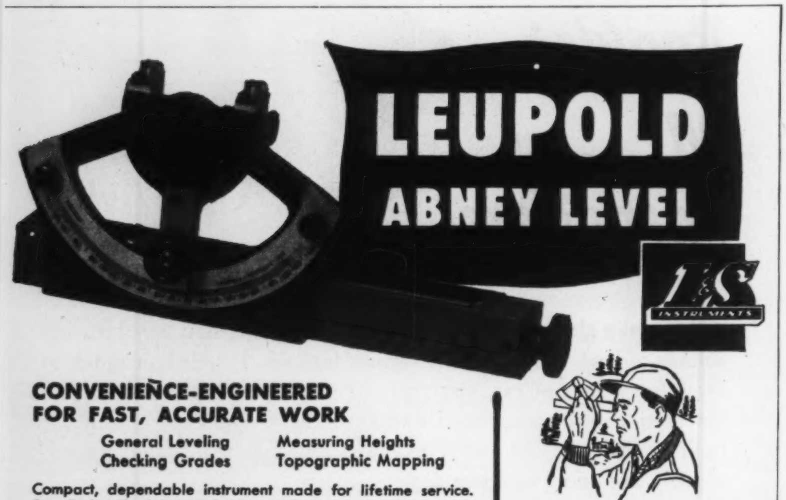
O. W. Israelsen, professor emeritus of irrigation and drainage at Utah State Agricultural College, is returning to the college to conduct research in the engineering phases of land drainage and irrigation after a round-the-world tour in connection with a technical assistance mission to India, Iran, and South Africa. For eleven months of his two-year stay abroad Dr. Israelsen served as professor of irrigation and drainage at the University of Roorkee in India.

Black & Veatch, consulting engineers of Kansas City, Mo., announce the moving and consolidation of their offices, now on the Country Club Plaza, to 1500 Meadow Lake Parkway.

Moses Eugene Cox has been appointed a special representative for Patchen and Zimmerman, engineers of Augusta and Atlanta, Ga., in their Atlanta office. He will assist in the development of the firm's expanding program of design for highways, bridges, and expressways. Previously Mr. Cox served as engineer and executive secretary of the Joint Bond Commission of Fulton County and the City of Atlanta and was in charge of all expressway development for the two.

Milton P. Adams, executive secretary of the Michigan Water Resources Commission, has been advised by President Eisenhower of his appointment to the Water Pollution Control Advisory Board of the U. S. Public Health Service. In his new capacity Mr. Adams will advise, consult, and make recommendations to the Surgeon General of the United States on matters of policy relating to the administration of the Federal Water Pollution Control Act of 1956.

James R. Libby, former chief engineer of the Freyssinet Company, Inc., and **Enis Y. Baskam,** former associate of Praeger-Kavanagh, Consulting Engineers, have entered into a consulting engineering partnership. The new firm has opened its offices at 151 Radcliff Drive West, East Norwich, N.Y., under the name, Libby-Baskam. Mr. Libby has been active in the field of prestressed concrete for the past six years and is on the ASCE-ACI Joint Committee 323 on Prestressed Reinforced Concrete.



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E. Warren Bowden has been elected executive vice-president of Walter Kidde Constructors, Inc., engineers and builders of New York and Houston. Mr. Bowden has been connected with the company since 1943, most recently as vice-president. The firm has done considerable work on projects for the Atomic Energy Commission.

William C. Alsmeyer has joined the Leo A. Daly Company, Omaha, Nebr., as structural consultant. He is a former associate professor of civil engineering at Iowa State College. He will serve the company's three offices—at Omaha, St. Louis, Mo., and Seattle, Wash.

A. Joseph Schrauth, of Oakfield, N. Y., has been appointed superintendent of the Herkimer (N. Y.) Municipal Commission. Until recently Mr. Schrauth was field engineer for the Pitometer Co., of New York, which has been conducting a water survey at Herkimer for the local commission.

Charles M. Noble is retiring as chief engineer of the New Jersey Turnpike Authority to become associated with the Ohio Department of Highways. He has been chief engineer with the Authority from its inception early in 1949, originally on a loan basis from the New Jersey State Highway Department where he held a similar position. While with the Turnpike Authority he had complete supervision of the design and construction of the 118-mile Turnpike, the Newark Bay-Hudson County extension, and the direct connection with the Pennsylvania Turnpike. He is a veteran of both World Wars, attaining the rank of captain in the Navy Civil Engineer Corps in the recent war.

Lewis K. Maires retired on December 31 from his position as supervisory engineer in the Bureau of Reclamation's engineering offices in Denver. He has completed 35 years of government service and has been with the Bureau continuously since 1933. A specialist in the design of irrigation canals and canal structures, Mr. Maires has supervised the design of many of the Bureau's large and complex irrigation systems, including irrigation features of the Columbia Basin and Missouri River Basin projects.

L. K. Maires

Dean Saville

Thorndike Saville, dean of the New York University College of Engineering for the past twenty years, has announced that he will retire at the start of the 1957 fall term—one year ahead of the time set by the university for its faculty members and administrators. He gave as one of his reasons the increasing number of requests for his services as consultant. Dean Saville is an authority in the fields of water supply, hydrology, and coastal engineering.

Benjamin E. Beavin announces the relocation of his firm, the Benjamin E. Beavin Company, engineers and surveyors, to 104 East 25th Street, Balitmore 18, Md.

O. W. Mintzer, until recently on the Case Institute of Technology engineering faculty, is now on a two-year assignment to the staff of Punjab Engineering College at Chandigarh, India. He is organizing a graduate program in highway engineering to assist Indian students in developing their country.

Franklin T. Matthias has been named chief engineer of the Aluminum Company of Canada, Ltd., succeeding **W. L. Pugh,** who is retiring. In addition to his new duties, Mr. Matthias will remain in charge of all construction for the company, with which he has been connected since 1952. As a young wartime colonel in the Army Corps of Engineers, Mr. Matthias won world renown for his work in building the Hanford, Wash., atomic bomb plant. Mr. Pugh will retain his connection with the company as consulting engineer.

Caleb M. Saville—a name long synonymous with Hartford, Conn., water supply—celebrated his 45th anniversary with the Metropolitan District of Hartford on January 1. Named manager and chief engineer of the district's Water Bureau in 1912, Mr. Saville headed construction of the Barkhamsted and Nepaug reservoirs. In 1948 he retired as head of the Water Bureau, which he still serves as consultant. Some of his long-time associates in the Bureau honored him on his anniversary with a brief ceremony at which he received a wrist watch from the Metropolitan District Commission as a token of appreciation for his half century of public service.

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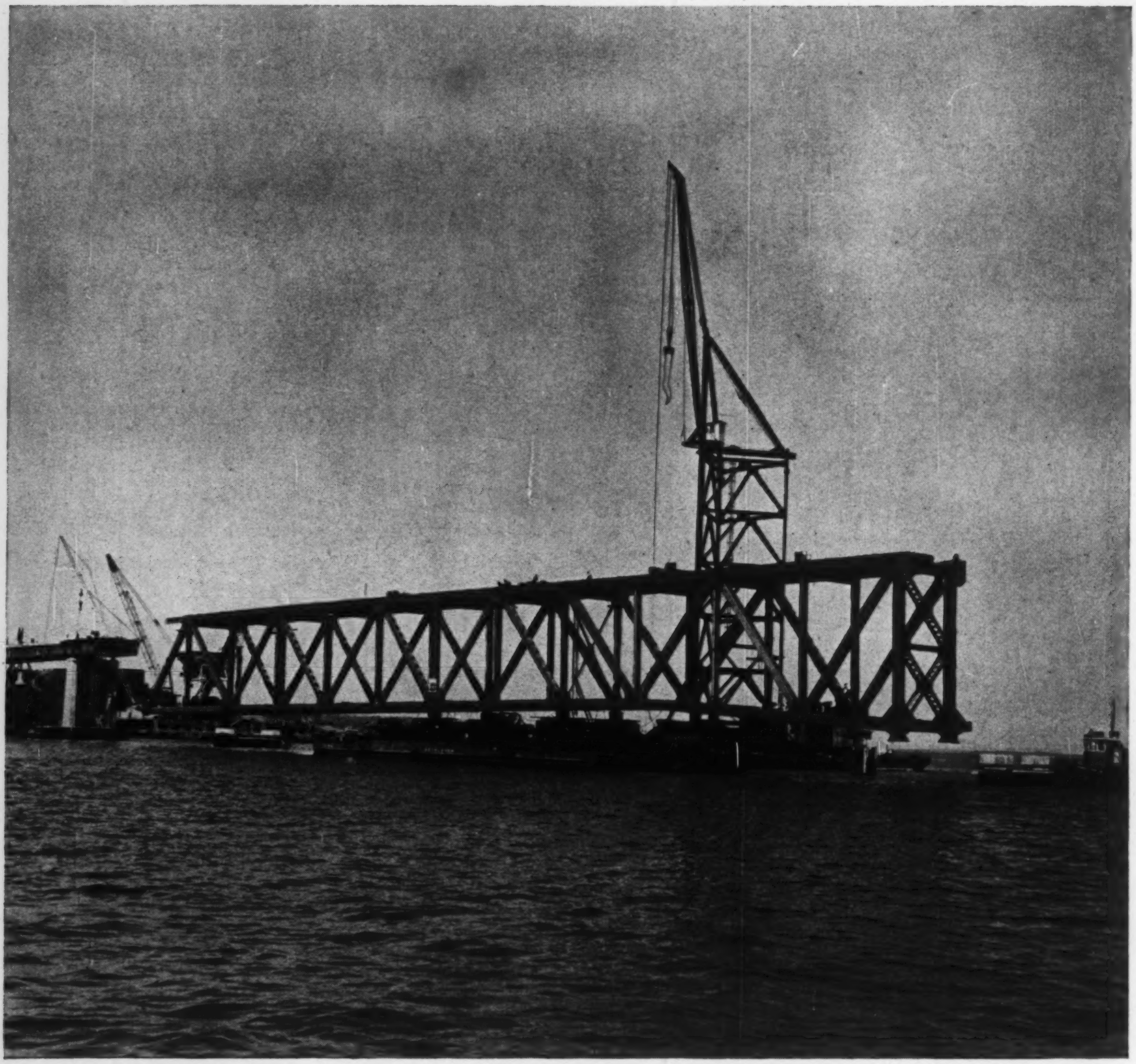

Modjeski & Masters, Harrisburg, Pa., are consulting engineers to the Virginia Department of Highways for design and construction of the Rappahannock River Bridge.

Floating in a big one

The truss span shown here is the first of fourteen to be floated into position on the Rappahannock River Bridge. It measures 351 ft in length and weighs 560 tons. The largest trusses to be erected by this method are the bridge's two 468-ft anchor spans which weigh 900 tons each. The 648-ft center span, largest span on the bridge, will be cantilevered out and joined at its midpoint over the main channel.

When completed, the 9,985-ft bridge will connect Grey's Point with White Stone, providing an important new link for Virginia's tidewater highway network. Design of the Rappahannock River Bridge calls for a total of fifteen truss spans and numerous beam and girder spans. The superstructure requires nearly 13,000 tons of steel, fabricated at Bethlehem's Pottstown, Pa., works.

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. . . . . Am-Soc Briefs

▶ ▶ The ASCE Group Disability Plan has again been broadened. At no increase in premium, coverage under clauses concerning partial disability, commercial flying, accidental death or dismemberment, and the maximum age for the loss of time contract have been extended (See page 67).

▶ ▶ Manual of Practice No. 35 is now off the press. Developed by the Committee on Research of the Hydraulics Division, the manual lists translations of foreign literature on hydraulics. Of particular value to hydraulic researchers in reducing duplication of studies abroad, the manual is 81 pages long and sells for $2.00 (half price of $1.00 to members of the Society).

▶ ▶ Recognizing that the time to start preparing for a career in engineering is in high school, ASCE's Committee on Engineering Education has issued a 16-page booklet, "You Can Be a Civil Engineer," aimed at the junior high school level. The booklet emphasizes what civil engineers do and what courses should be taken in high school to prepare for college. It will be widely distributed to guidance groups.

▶ ▶ The Maine Section, in cooperation with the State Highway Commission and the University of Maine Student Chapter, played host to 225 at its Seventh Annual Highway Conference. Theme of the conference was "Highway Materials". . . .

▶ ▶ With this issue, CIVIL ENGINEERING resumes its coverage of the Washington scene. In this day of mammoth federal budgets and huge public works programs, the happenings in the District loom large on the engineering horizon. With the addition of a correspondent familiar with the corridors and cloakrooms of the capital, the editors hope to better serve ASCE members.

▶ ▶ The St. Lawrence Seaway construction takes center stage for the upcoming Buffalo Convention. The planned tour of this $600,000,000 project should not be missed. Mark June 3-5 on your calendar.

National Prestressed Pools

One of the largest motel swimming pools under construction at the Blue Spruce Motel, Murrysville, Pa.

Pre-Stressed, Pre-cast Concrete Units Solve Labor Costs

The NATIONAL POOL package includes all fittings special interlocking concrete units, vertical pre-stressing bars, marble-lite material for interior finish and complete filter system. Construction requires no special equipment and can be done with inexperienced local labor. Specially designed pre-cast interlocking concrete wall sections fit into each other and solves cost problem. Pool walls are scientifically pre-stressed to prevent cracking. New method puts swimming pools within reach of all budgets.

PRICES START AT $1,300.00 for 16′ x 32′ PRIVATE POOL COMPLETE WITH FILTER SYSTEM, PUMP, MOTOR AND FITTINGS. PUBLIC POOL PACKAGE PRICE STARTS AT $3,464.00 for 20′ x 40′ POOL. PUBLIC POOL PACKAGES ARE AVAILABLE FOR OLYMPIC SIZE POOLS.

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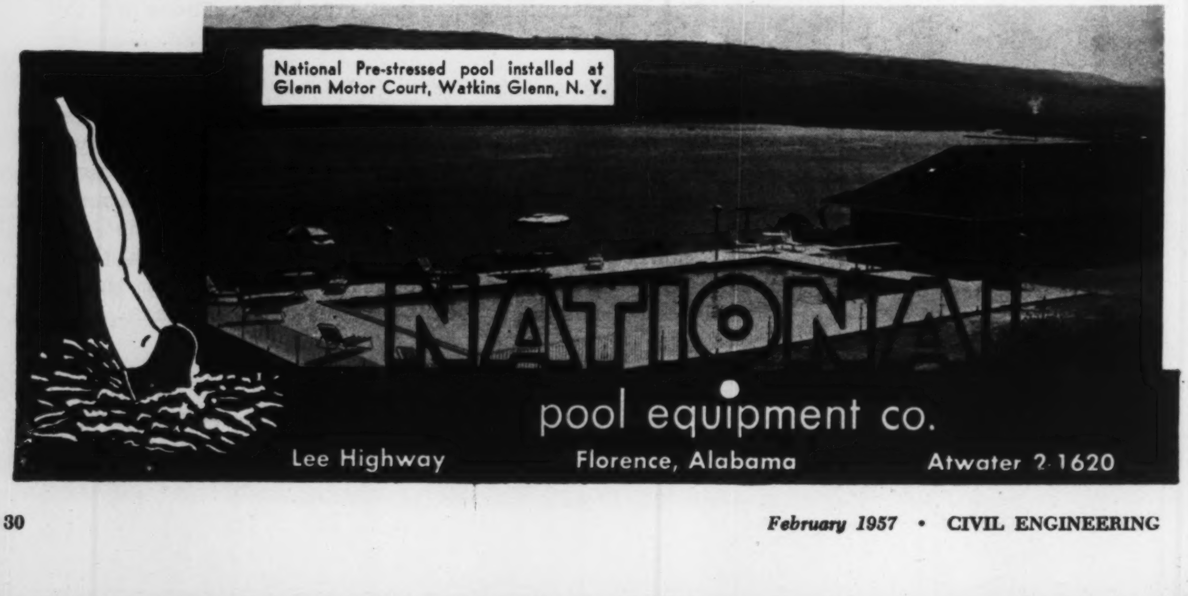
National Pool retains a highly specialized engineering staff for pool designing and construction. Services available to Architects and Engineers.



National Pre-stressed pool installed at Glenn Motor Court, Watkins Glenn, N. Y.

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do you know that

More than one dollar out of every seven spent in the United States last year was invested in construction? In addition, construction accounted for almost 15 percent of our total employment. The 1956 construction year, which saw dollar volume of new work and maintenance pass the $60 billion mark, is reviewed on page 84.

• • •

The American steel industry can now produce more than 40 percent of the world's output? This word comes from Benjamin F. Fairless, M. ASCE, president of the American Iron and Steel Institute, who reports a new annual figure of 133,459,160 tons — an increase of 5,096,060 tons over our capacity a year ago.

• • •

A monorail line is being built in Florida? The 1,250-ft line will have a 26-passenger coach of Fiberglas and steel suspended from a rail 27 ft overhead. Under construction near Fort Lauderdale, it will be used as a shuttle service between U.S. Highway 1 and the Autorama — a transportation display. The builder, Monorail of Florida, will apply to the state for authorization to build and operate a Skyway Monorail between Miami, Miami Beach, Fort Lauderdale, and Palm Beach.

• • •

Highest average starting salaries go to engineers? A recent Northwestern University survey shows that young engineer graduates are being offered the highest average starting salaries, $433 a month. Industry will be on the look-out for 10,000 graduates this year. Ten years after graduation the engineering picture is not so bright. By then, according to the survey, the average salary for engineers is $740 a month as against $826 for men in sales. Accounting and general business also command higher salaries ten years out.

• • •

First basic research is being done on the wheel? Though the wheel is one of man's earliest inventions, engineers are only now getting around to the first long-term research on the subject. So says Prof. Edward T. Vincent, head of a long-range study of wheel performance at the University of Michigan's new Automotive Engineering Laboratory. The wheels are towed through sand, mud, clay, rocks, and other off-road materials in a 40-ft trough, and the amount of resistance, slippage, and sinking is measured.

The stabilization lagoon as an inexpensive method of treating sewage is being investigated in several states by federal water pollution control engineers? Outstanding success in use of the lagoons in experiments in North and South Dakota has led to adoption of the system by 136 communities. The lagoon—a shallow, outdoor collection pond where the sewage is treated by natural, biochemical action, largely through photosynthesis and the action of algae—has been found efficient in all climates in this country. It gives promise of cutting by two-thirds the cost of conventional plants providing the same treatment. The Robert A. Taft Sanitary Engineering Center in Cincinnati is headquarters for the investigations.

• • •

Good progress is being made in launching the new National Highway Program? According to John A. Volpe, interim highway administrator, the detailed location of more than half the 40,000-mile system has already been established. Eighteen states and the District of Columbia have determined the exact location of over 75 percent of their portions of the system.

• • •

This is an important anniversary year for the Coast and Geodetic Survey? A year-long series of public events will mark the 150th anniversary of the Survey which was established under President Jefferson, in February 1807, as the Government's first technical bureau. The Survey has chalked up to its credit the charting of more than 100,000 miles of coastline and recently completed a study of the Arctic coast of Alaska.

• • •

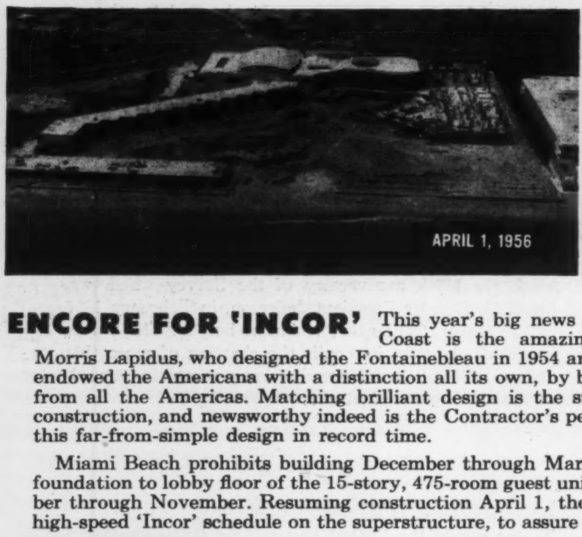
Water use in the United States is up 34 percent since 1950? In other words, hydrologists of the Geological Survey report, we are using 440,000 mgd more water than we did five years ago. Water for power generation — about 1,500,000 mgd — is by far the largest use. Industry comes second and irrigation is a close third.

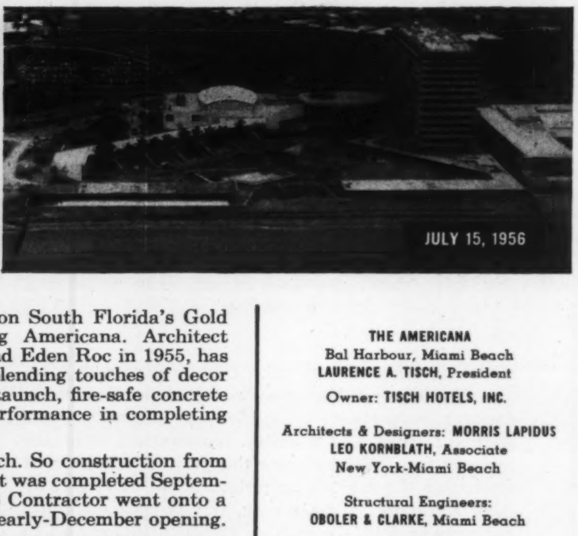
• • •

A highway issue of Civil Engineering is coming up? In keeping with the importance of highways in the national picture, the March issue will be devoted to construction aspects of the highway program. An article by Federal Administrator Bertram Tallamy on administering the program and a review of trends in construction equipment are among the notable articles.

Amazing Americana

Floor-a-Week Frame Construction . . . 50% Form Saving


APRIL 1, 1956


JULY 15, 1956

ENCORE FOR 'INCOR' This year's big news on South Florida's Gold Coast is the amazing Americana. Architect Morris Lapidus, who designed the Fontainebleau in 1954 and Eden Roc in 1955, has endowed the Americana with a distinction all its own, by blending touches of decor from all the Americas. Matching brilliant design is the staunch, fire-safe concrete construction, and newsworthy indeed is the Contractor's performance in completing this far-from-simple design in record time.

Miami Beach prohibits building December through March. So construction from foundation to lobby floor of the 15-story, 475-room guest unit was completed September through November. Resuming construction April 1, the Contractor went onto a high-speed 'Incor' schedule on the superstructure, to assure early-December opening.

Forms filled with concrete one day, stripped and jumped the next . . . structure topped out July 15 . . . 14 stories and roof erected in as many weeks. Typical 'Incor'* results: 50 to 60% saving on forms . . . faster completion, less job overhead . . . earlier rentals . . . quality concrete, with high ultimate strength matching high-early performance. Duplicating similar record on Fontainebleau and Eden Roc . . . another encore for 'Incor.'

*Reg. U. S. Pat. Off.

THE AMERICANA
Bal Harbour, Miami Beach
LAURENCE A. TISCH, President

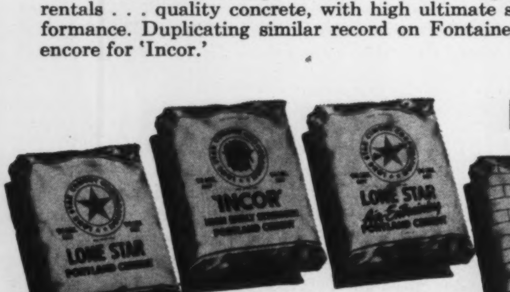
Owner: **TISCH HOTELS, INC.**

Architects & Designers: **MORRIS LAPIDUS**
LEO KORNBLATH, Associate
New York-Miami Beach

Structural Engineers:
OBOLER & CLARKE, Miami Beach

Contractor:
TAYLOR CONSTRUCTION COMPANY, Miami

Ready-Mix 'Incor' Concrete
MAULE INDUSTRIES, INC., Miami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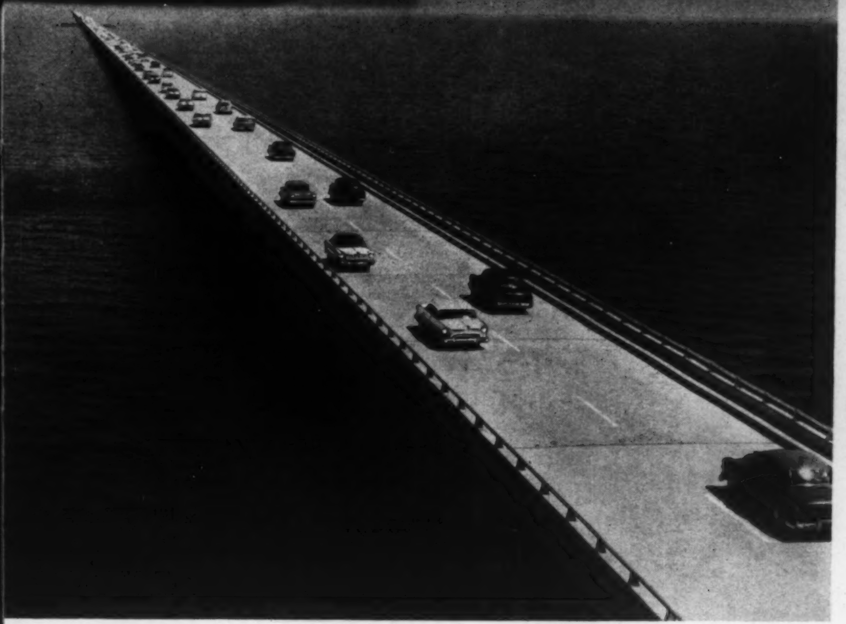


CIVIL
ENGINEERING

MYERS VAN BUREN, M. ASCE
Engineer, Raymond Concrete Pile Company, New York, N.Y.

Concrete bridge across Lake Pontchartrain completed in record time

The recently completed Lake Pontchartrain Causeway, because of its record-breaking length and short construction time, has received considerable publicity both in newspapers and in engineering journals. However, very little has been written that explains how a concrete bridge of this length could be built so quickly and so economically. It was done on a production-line basis, by casting and placing hundreds of parts all alike.

This bridge traverses Lake Pontchartrain in a north-south direction, with the south terminus just west of the city of New Orleans, La. (Fig. 1). Its length of 23.83 miles, shore-to-shore, makes it the longest highway bridge in the world. Except for the two bascule spans and three humps for the passage of water traffic, there are no vertical or horizontal curves in its entire length.

The engineers, Palmer and Baker, Inc., of Mobile, Ala., conceived a design that was tailor-made for a con-

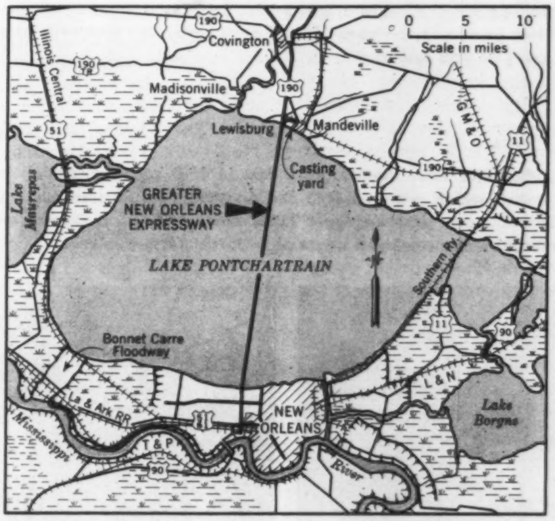
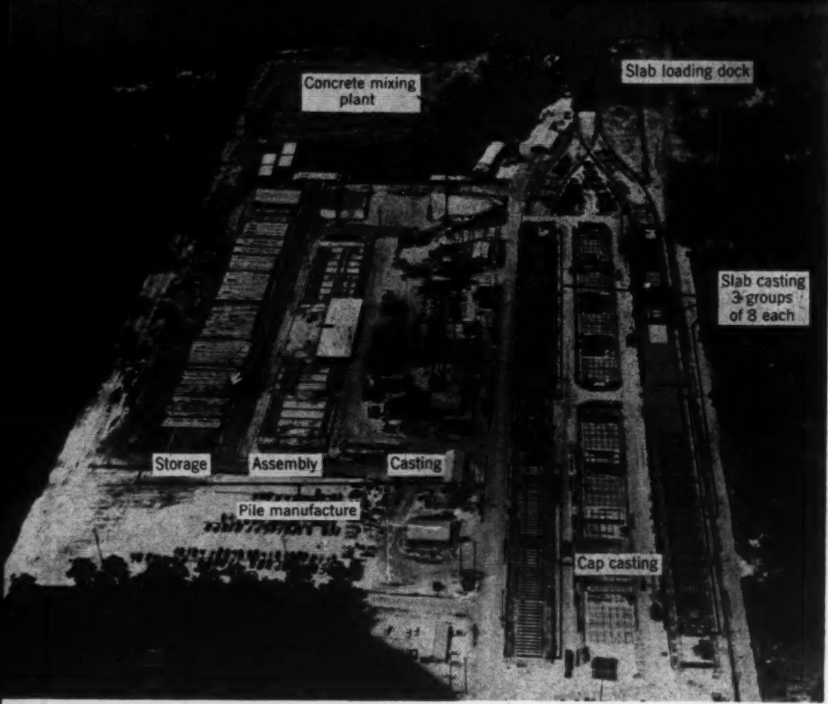

190
Covington
0
5
10
Scale in miles
Illinois Central
190 TR
Madisonville
190
Lewisburg
Mandeville
G M & O
11
51
190
Casting yard
Lake Maurepas
GREATER NEW ORLEANS EXPRESSWAY
LAKE PONTCHARTRAIN
Southern Ry.
11
90
Bonnet Carre Floodway
L & N
La & Ark RR
61
NEW ORLEANS
Lake Borgne
Mississippi
T & P
90
River

FIG. 1. Toll bridge 23.83 miles long from shore to shore, is longest highway structure ever built. It connects New Orleans with north shore of Lake Pontchartrain.


Concrete mixing plant
Slab loading dock
Slab casting 3 groups of 8 each
Storage
Assembly
Casting
Pile manufacture
Cap casting

Casting yard at Mandeville is supported on 8,000 wood piles to assure unyielding support for forms used in precasting the bridge elements. Here nearly 7 million dollars were spent on foundation machinery, forms, cranes, mixers, trackage, dredging, marine equipment, and barge loading facilities, before first cubic yard of concrete was poured.

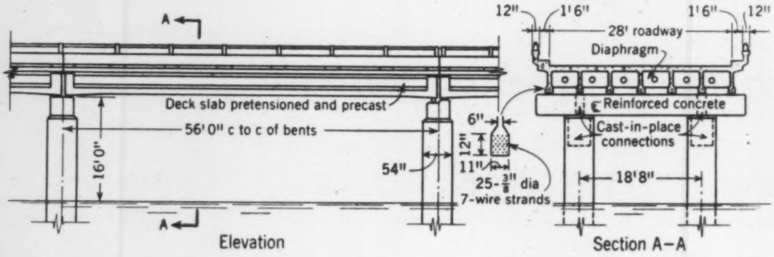
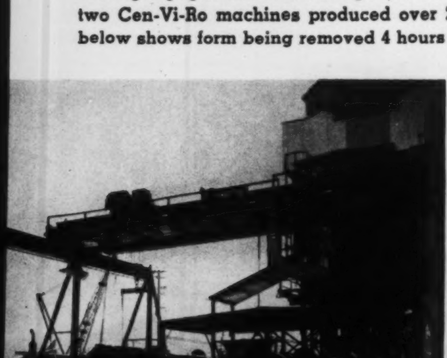
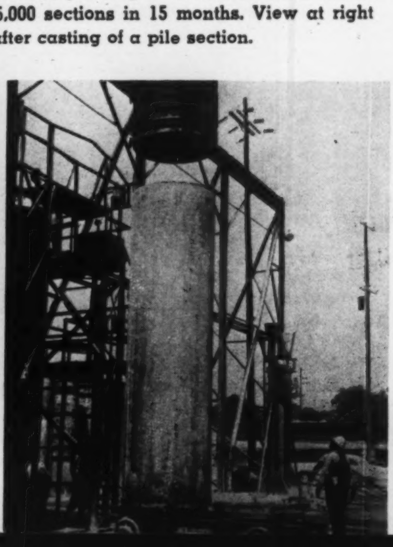
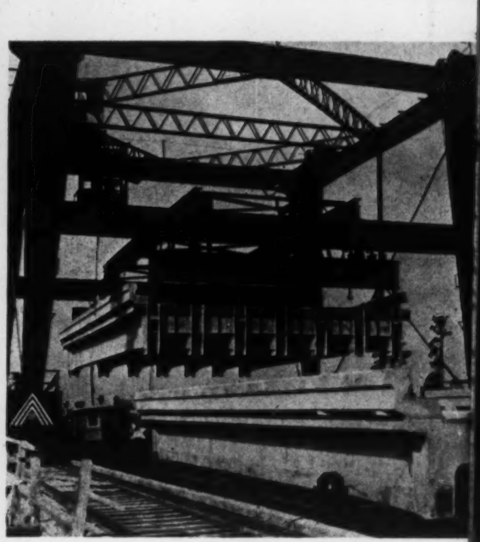

A
A
Deck slab pretensioned and precast
56'0" c to c of bents
16'0"
54"
6"
12"
11"
25-$\frac{3}{8}$" dia 7-wire strands
Elevation
12"
1'6"
1'6"
12"
28' roadway
Diaphragm
Reinforced concrete
Cast-in-place connections
18'8"
Section A–A

FIG. 2. Assembly-line mass-production techniques were used to precast piles, caps, and deck slabs for total of 2,215 identical bents. Each bent consists of two piles and one cap, and two bents support each 185-ton deck slab. Last slab was placed 14 1/3 months after first pile was driven.

Piles of 54-in. diameter were centrifugally cast in 16-ft sections. At left below, pile casting equipment, which completed 85 sections per day, is seen in action. These two Cen-Vi-Ro machines produced over 25,000 sections in 15 months. View at right below shows form being removed 4 hours after casting of a pile section.





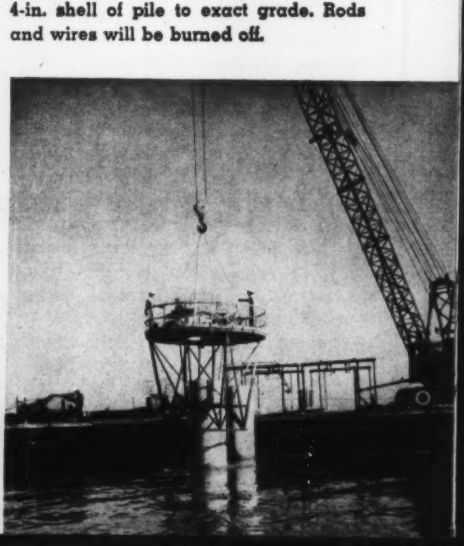


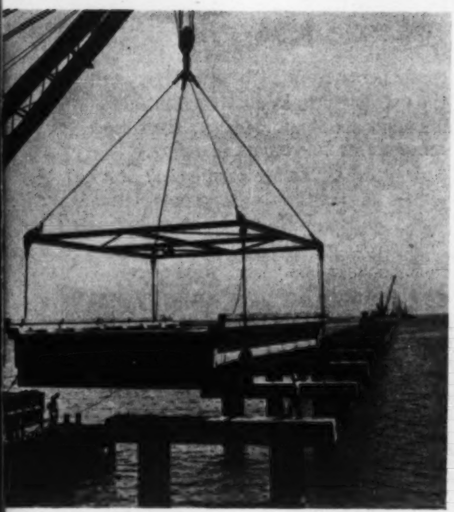
Completed deck slabs less than 48 hours old are being loaded in casting yard for barging to bridge site. Each barge carried two slabs. Note that slab in gantry crane is being lifted by end forms, which were left in place until slab was loaded onto barge.

tractor with the imagination and forethought to organize a mass-production, assembly-line operation. The contractor, Louisiana Bridge Company, a joint venture of Brown and Root, Inc., of Houston, Tex., and T. L. James and Co., Inc., of Ruston, La., was just that type of organization.

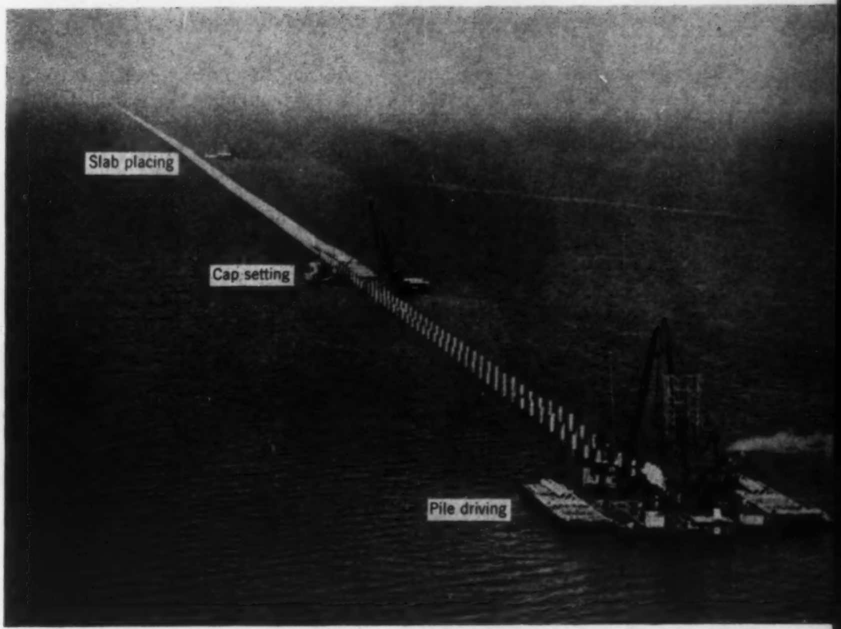
The bridge has 2,215 identical bents (Fig. 2), which account for 98 percent of its length. Except for the aluminum handrail and less than 4 cu yd of cast-in-place concrete, each bent consists of four precast elements

Cap setting operation required cutting off piles to grade, placing a cap to exact line and grade, and pouring connecting concrete around reinforcing inserted into top 4 ft of pile. Here platform is lowered from which two jack-hammers, operating on circular track, cut 4-in. shell of pile to exact grade. Rods and wires will be burned off.





Setting of 185-ton floor slabs was an easy operation because of precision casting of elements and precision placing of bents. Fourteen bearing plates cast integrally with slab, one at each end of each beam, engaged the 14 plates cast into the two caps within average tolerance of 1/32 inch.



Eight 56-ft bents erected in place, or 448 ft of bridge length, was one day's task. Here is the marine spread at work—pile driving, cap setting, and slab placing. At times pile driving was three miles ahead of slab setting.

—two piles, a cap, and a slab. The 30-ton piles are 54 in. in diameter; the cap weighs 30 tons, and the 185-ton slab is 56 ft long by 33 ft wide. Cast-in-place concrete was used to make the connection between the cap and the piles. The finished roadway surface is the top of the deck slabs just as they left the casting yard.

The slab has a 28-ft roadway, a curb 10-in. high, and an emergency walkway 18-in. wide on each side. Above each walkway there is a continuous concrete guard rail 1 ft high, topped by an aluminum tube of 4-in. diameter set 12 in. above the concrete. See Fig. 1.

Casting-yard techniques

Each slab was cast integrally with the seven longitudinal prestressed beams, which are 4 ft 5 in. deep measured from the roadway surface, and spaced 4 ft 8 in. on centers. Each beam was pretensioned with twenty-five wire strands of ⅜ in. diameter.

The pile caps, each 32 ft long, were also precast. Designed for normal reinforced concrete they are 3 ft 6 in. wide by 3 ft 0 in. deep for expansion bents. Each cap was connected with each of its two foundation piles by a plug cast in the top 4 ft of the hollow pile after the cap was in place. This concrete was poured through a hole provided in the cap. The plug reinforcing steel was attached to the cap as an integral part of its reinforcing and extended down into the top of the pile.

Piles are of Raymond cylinder type, of hollow prestressed concrete 54 in. in outside diameter, with a wall 4 in. thick and a uniform cross section from point to top. The use of hollow, large-diameter piles made the use of precast caps possible. Solid piles or hollow ones of small size would have made cast-in-place caps necessary, and thus would have demanded a much more expensive and time-consuming method.

Contract time for construction of the bridge was 23 months starting on January 20, 1955, and ending December 20, 1956. The contract was for $27,600,000 and provided a penalty of $6,000 per calendar day after the expiration of the contract time.

The contractor estimated that with a mass-production assembly-line technique for casting the various elements, and with precision dimensional control in both casting and placement, a construction schedule of 20 months could be met. A schedule of 8 slabs per day was set up. This required, on each working day, both the casting and the installation of 8 slabs, 8 caps, and 16 piles.

Based on past experience and special tests for this particular job, the contractor determined that the concrete strength of 3,000 psi required before the prestressing wires in the slab could be released, would be achieved within 36 hours. This made possible a three-day casting cycle. Therefore, three groups of 8 slab forms were provided to meet the casting schedule of 8 slabs per day. Cap casting and pile production were planned to dovetail with the slab schedule.

One of the many unusual features of the casting yard was the absence of any slab storage area. The eight slabs cast on Monday had to be removed from their forms on Wednesday and placed in the bridge the same day. This operation required careful scheduling between the yard crew, the marine transportation, and the placing crew.

The group of eight slab forms which made up a single daily operational unit were set end to end, to perfect alignment and grade. This was necessary so that all of the twenty-five ⅜ in. prestressing strands could be stressed as a single unit. A car holding the 25 coils serviced each of the three groups of slab forms. This car ran on a cross-travel track so that its center could align, in turn, with each of the seven beam locations in each slab. All the ⅜-in. strands for a beam were pulled simultaneously through the eight slabs with a stationary single-drum winch at the opposite end from the car. Telephone communication was necessary between the winch operator and the car supervisor. Each of the seven groups of strands were stressed by individual jacks, all piped to a common hydraulic pump. Through the valving arrangement, each jack could be stressed individually, or all or any particular group could be stressed simultaneously. Each strand was held at each end by a reusable anchorage.

The engineers had made two alternative designs for the beam part of the slab. One design was for beams with no bottom flange and a tapered web narrower at the bottom. This design would allow stripping from fixed forms. The other design had a bottom flange and a thinner web, and would require removable side-beam forms. This latter design had the advantage of being lighter and of requiring less concrete and steel. Although the difference in quantities was not great for one slab, for the entire job the savings in materials and weight handling were of some magnitude. The contractor elected to use the latter method, with its saving in weight and materials.

Having decided to use the slab design requiring beams with bottom flanges, the contractor was faced with the problem of form stripping. In order to permit workmen to get into the interior bays between beams and diaphragms, the forms would have had to be elevated. This would have increased the cost, not only of the support for the forms themselves, but also of that for the reaction beams for the pretensioning. Stripping of the interior bays by remote control seemed to be the answer. This remote control was provided by attaching the side forms of the beams to a series of fixed screws at right angles to the beams. Turning the screws moved the forms forward or back along the screws. Turning in one direction placed the form in position, and turning in the opposite direction stripped it. Form stripping or setting was done in a matter of minutes. Each form was reused more than ninety times. The screw devices worked exceptionally well throughout the entire job.

The problem of how to lift the slab from the casting bed was solved in a novel way. The end forms were so designed that they served as lifting beams, and the handling crane was hooked directly into them. They were not removed until the slabs had been lifted from the casting bed, transported to the loading-out area, and placed on a barge. For handling the slabs a specially designed diesel-electric gantry crane of 200-ton capacity was used. This traveled on two standard-gage tracks, one on each side of the aligned slab forms. In addition to handling the slabs, this crane also serviced the cap casting area, where it handled six 30-ton caps simultaneously.

Casting of the 30-ton caps followed normal techniques, except that they were cast upside down. This was done for two reasons: (1) to enable the bearing plates to be cast integrally with the cap, and (2), to allow the pile plug reinforcing, which is a part of cap reinforcing, to extend 4 ft out of the cap and at right angles to it, at the pile locations.

The most daring and unusual technique used by the contractor was the casting of all bearing plates integrally with the caps and with the slabs. Each slab, and each cap as well, had 14 bearing plates. In the slab they were at the ends of each of the seven beams. The plates were of usual design with a flat plate in the slab and a curved plate in the cap (for the fixed bearings). At the expansion bearings, rockers 6 in. high were used, and keyed into flat plates in the cap and slab. Only in the exterior bearings were there anchor bolts.

In arriving at the decision to cast all bearing plates in the caps and slabs, the contractor received little encouragement from outside sources. Most considered it impractical. Among the contractor's personnel directly concerned with the planning of the job, there was no agreement on this point. However, the decision was made, and the construction schedules were set up on the basis that it could be done. Had the idea not been successful much money and time would have been lost as the forms and casting beds would have had to be rebuilt and the cap and slab setting techniques altered. The idea worked even better than had been expected by its most ardent proponents. Shims were required in less than one bearing in seven and the average shim was less than 1/32 in. thick.

How is it possible to cast steel plates so that the surfaces of an average of 12 of each 14, spread over an area 28 ft x 56 ft, will not vary from a plane surface by more than 1/32 in.? The answer was, first, to set the plates to within the 1/32-in. tolerance before pouring the concrete, and second, to provide a foundation which would not settle differentially during concrete pouring and curing. The first was accomplished by a diligent survey crew, which checked every plate in every slab and cap just before the concrete was poured. The second was accomplished by having a completely firm foundation under all the forms.

To be sure of having a good foundation on which to cast precisely, the contractor drove over 8,000 bearing piles in his yard area. These piles vary in length from 15 to 80 ft. This is a surprisingly large number of piles considering that less than 5,000 piles were driven to support the entire bridge length of nearly 24 miles. Possibly fewer piles would have been sufficient to support the yard where the bridge components were to be cast, but with the extremely tight construction schedule, and the high penalty, there was no room for inadequate planning.

Another departure from usual techniques in precast bridge construction was that the surface of the slab was finished to exact grade and camber—both longitudinally and transversely—in the yard. No road surfacing was applied after the precast deck units were set. To accomplish this aim, a negative longitudinal camber was required originally, as the release of the pretensioned steel humped the slab. One force offset the other, leaving a level slab in the longitudinal direction.

Piles cast centrifugally

To meet the pile specifications, the contractor decided to use the Raymond cylinder pile. This is a round, hollow, sectional prestressed concrete pile developed by the Raymond Concrete Pile Company, and widely used for marine installations both inshore and offshore in the Gulf of Mexico. Experience indicated that this pile could be made and driven without trouble.

As with the slabs and caps, careful control of materials and precise dimensional control of concrete units for the piles were imperative. Each pile is made up of a number of units of 16-ft length, a single shorter unit being used where required to secure the desired length. The Cen-Vi-Ro casting technique makes simultaneous use of centrifugal (Cen-) force, external vibration (Vi-) on the form, and high compression rolling (Ro) on the interior surface of the tubular section. With this, a 6.75-sack mix, using not over 3.7 gal of water per sack of cement, is consolidated until excess water is forced out.

As the water has the lowest specific gravity of the ingredients in the mix, it comes to the inside surface of the tubular section under centrifugal action. When spinning stops, this excess water flows out of the form. The presence of water on the inside surface of the spinning concrete tube is the signal that all of the semi-dry mix has become compacted to a point where all voids are eliminated. With the use of graduated steam curing from 90 to 165 deg F for a period of about three hours, the concrete was strong enough at the end of this period so that the forms could be stripped. This permitted each form to be used twice during an 8-hour shift. A concrete strength of over 4,000 psi was attained at 24 hours, and over 8,000 psi at 28 days.

As in the casting of the slabs and caps, exact dimensional control was required in casting the cylinder pile sections. The end surfaces of the sections, which abut against each other when the pile is put together, were formed to a plane surface at right angles to the axis of the pile within a tolerance of 1/32 in. across the 4-ft 6-in. diameter of the pile. This accuracy, necessary for economical pile assembly, was attained by having carefully machined casting surfaces on the forms and by having the forms strong enough to resist distortion during casting and curing.

The cylinder pile sections had 12 equally spaced parallel and longitudinal holes of 1⅜-in. diameter cast in the 4-in. wall. After assembling the required number of sections to make a pile of given length, the sections were aligned end to end and rotated until the 1⅜-in. holes were in alignment. During assembly and before prestressing, the joint surfaces of the sections were spread with a special resin glue. Twelve M.B. oil-tempered wires of 0.192-in. diameter were placed in each of the 12 holes. These wires were stressed using individual jacks, usually in pairs, for each group of 12 wires. After proper tensioning with the jack, the wire stress was maintained by temporary reusable anchorages, which held the 12 wires as a group. The space within the 1⅜-in. hole around the 12 wires was then pressure grouted. The temporary anchorages were removed after the grout had set sufficiently to hold the wire tension, usually 24 hours in warm weather, and up to 48 hours in cooler weather.

Careful erection scheduling

Installation of the precast units required as much ingenuity, careful scheduling, and line and level control as did the casting operation. Often the operation of the survey party on a construction job receives very little attention. This was not so here. Much thought was given to having the field party where it was required when required. Scaffolding and special supports were set so that the engineers could get close to each work area at any time. Sometimes the pile driving was as much as two miles ahead of the cap setting, and three miles ahead of the slab setting.

Specifications allowed a pile to be as much as 6 in. out of location but seldom was a pile more than 2 in. out. The caps could not be out of location more than ⅛ in. as the anchor bolts in the caps had to thread through the upper bearing plates in the slabs at all four corners. Double and triple checks on accuracy were standard procedure.

Installation of the precast units started at the north abutment and proceeded southward. Except for the special work at the turnaround in the middle of the bridge, the two bascules and the three humps, the operation was continuous—always southward since the equipment never backed up. Only one set of pile-driving equipment, one set of cap-setting equipment, and one slab-setting rig were used. Except for the six special areas, workmen could drive a car from the north abutment onto the last slab set each day. The bridge up to that point would be entirely completed except for the installation of the hand rail and expansion-joint plates. This feature made transportation of men to the site of the work much less costly, especially when the work had advanced far out from the base of operations on the north shore.

The pile driving schedule of 16 piles per day was maintained with the use of two barge-mounted whirlers working together, one on each side of the bridge centerline. Normally each rig drove only one pile per bent, but in case of trouble either rig could drive both piles. A template two bents long (112 ft) was used to spot the piles on location. This template hung from the last two groups of piles driven and cantilevered 56 ft to the next bent to be driven. After driving, this template was picked up by one of the whirlers and moved forward one bent. To enable the engineers to keep close to the work, catwalks were laid from bent to bent as the work progressed. At the end of each day, all except the last few catwalks would be picked up to make ready for the next day's slab-laying operations.

After any high piles had been cut off to grade, the caps were set by a jig on the two piles in a bent. This jig allowed the cap to be moved over either pile in any direction—east or west, north or south, up or down. The engineers, working from platforms laid on the caps previously set, could then direct the cap setting to precise line, grade, and distance. After a cap had been set precisely, the pouring of about 4 cu yd of concrete completed the operation. No form was required except for a diaphragm hung inside the pile as a bottom form, and a band around the top on the outside, if the top was below grade. No reinforcing steel had to be placed, since all that was required had been placed in the casting yard and was projecting from the cap when it was shipped from the yard.

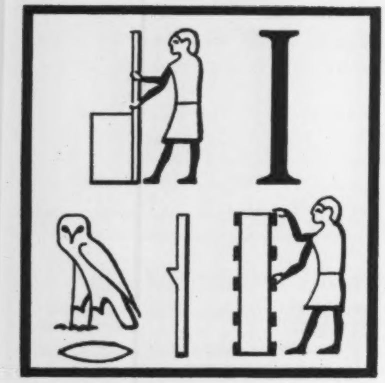
In some way the slab setting seemed anticlimactic. No doubt this was because all the precision work had been completed in the casting of the slab and the caps, and in the setting of the caps. However, until the slab was actually set, there was no certainty that the 28 bearing plates (14 in each slab and 7 in each cap) had been cast (in slab and caps) and set (in the caps) to precise grade, and that the eight anchor bolts (2 in each outside cap bearing plate) had been set exactly square and in alignment. The slab setting was accomplished with a special barge-mounted crane capable of handling 200 tons. In rough weather the slab setting could become a difficult operation. However, there were very few days when the scheduled number of slabs—eight—could not be set.

Construction of the casting yard at Mandeville, close to the north terminus of the bridge, began on January 20, 1955. Casting of pile sections began on April 24, 1955, casting of caps on May 15, 1955, and casting of slabs on June 8, 1955.

The first two pile bents were driven on May 23, 1955, and the last one—nearly 24 miles away—on June 24, 1956, that is, in a period of 13 months. The last slab was set on August 4, 1956, only 14⅓ months after the first pile was driven. The bridge was turned over to the owners and opened for traffic on August 30, 1956, nineteen months and ten days after the starting date and three months and 20 days before the contract completion date.

On a project of this magnitude it is difficult to give due credit to the many people who assisted in conceiving, planning, and executing the work. However, mention must be made of the following. With Palmer and Baker, Inc., were Wayne F. Palmer, M. ASCE, President; Rear Adm. William H. Smith, M. ASCE (Retired), Chief Engineer; Kenneth C. Roberts, M. ASCE, Assistant Chief Engineer for Design, Adm. L. N. Moeller, M. ASCE (Retired), Assistant Chief Engineer for Construction, and Gen. Joseph J. Twitty (Retired), Resident Engineer. With Brown and Root, Inc., were Ross White, M. ASCE, Vice President, and M. P. Anderson, Vice President and Chief Engineer. With the Louisiana Bridge Company were J. E. Walters, Project Manager; Walter Gossaway and James Quillan, General Superintendents; and D. W. Milhan, A.M. ASCE, Chief Engineer. Credit also must be given to the Raymond Concrete Pile Company as consultants on the cylinder piles and to the Freyssinet Company as consultants on the slab stressing beds. The bridge is owned by the Greater New Orleans Expressway Commission.

Photographs used to illustrate this article were made by Glo-Ad Photographies of Mandeville, La., and by Frank Lotz Miller, of New Orleans.



The engineer through

As early as 2800 B. C. several titles appear in hieroglyphs translated by Breasted as "Master Builder" or "Chief of Works." In the design at left, upper ideograph refers to construction work, while lower reproduces one of these early titles and may be translated as "he who is in the mouth of the builders."

J. K. FINCH, M. ASCE

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I. The Chief of Works of Ancient Egypt

Turning back the pages of history in a desire to know more about his professional ancestors, or through curiosity, the engineer of today soon uncovers not only a number of fascinating and pertinent records but also many still unresolved historical jig-saw puzzles. Unfortunately factual evidence is often lacking or grossly exaggerated. Archeological research has emphasized records and objects of art rather than men and methods of construction. Thus, while much is available on the birth of engineering in ancient Egypt some fifty centuries ago, there are still many parts of the story on which we should like to have additional information. We are dealing however with the remote past, the dawn of civilization, the beginnings not only of engineering but also of recorded history, and such records are naturally far from complete.

Somewhere in the long, narrow and fertile valley of the Nile, which stretches from the river's great delta for 700 miles to the First Cataract at Aswan, early man developed a new way of life in which engineering played a major role—a way of life we still carry forward today. Historians picture man as suddenly emerging from the mists of the past, from the perils and uncertainties of a nomadic existence subject to the hazards and whims of nature, to a remarkable degree of control over his environment and material existence.

Barbarism gave way to civilization and this change was strikingly reflected in the work of the earliest engineers, the Master Builders. In a brief century and a half, these builders passed from the use of rough stone blocks to the building of the greatest stone masonry structure the world has ever known, the Great Pyramid. In the same period, we are told, the Nile became dotted with boats exchanging the products of pioneer industries for the necessities supplied by Egypt's agricultural and other areas—a result of the first industrial revolution.

What do we know of the men who planned and directed these pioneering accomplishments? What were the forces that controlled their efforts?

Egyptian life and economy developed in this same period into a form which, in its major features, was to endure throughout her long history. This was the Golden Age of ancient Egypt—the Pyramid Age—which lasted from about 3000 to 2500 B.C. Government and religion centered in the king, the priests and nobles of his court, and the governmental bureaucracy that evolved around them. The major undertakings were royal works, and a highly organized administration seems to have come into being in the earliest days. In this hierarchy our engineering forerunners held top positions as the trusted advisers and representatives of the king. As might be expected in a highly organized society, these planners and directors had numerous foremen, scribes, and other administrative and technical assistants at their command.

When we attempt to picture the basic factors and conditions which dictated the planning and building of those days, we soon discover that we are indeed in a strange land. Topography and geology were kind to the ancient Egyptians. The Nile not only irrigated and replenished the land but met all transportation needs. No road building was required. While timber was lacking, various grades of stone, from limestone and sandstone to the hardest granite and quartzite, were available close to the great river. Stone soon replaced the earlier mud brick in all major structures.

While the modern engineer immediately feels a kinship with the later Greek builders who employed surveying techniques still basic today and sought the most economical use of labor, he has difficulty identifying himself with the Egyptian builder, who used but one material and had unlimited labor at his command. After more detailed study, however, the modern engineer finds that the interesting ways in which the Egyptian builder met this challenge command his admiration. Clearly the search for permanence was a basic element. The king or noble was the major client and he sought a lasting tomb to preserve his remains in accordance with his religious beliefs.

But there was also the element of time. How could unlimited labor best be employed to secure the desired results in the least time? Although the tremendously laborious quarrying, transporting, and construction methods clearly show no interest in "labor saving" in the modern sense, the Egyptian master builder, probably the greatest organizer and director of labor the world has ever known, cleverly handled his labor force to meet the perfectly human desire of his clients to see their structures completed in the shortest possible time.

The two lands—Upper Egypt, the narrow valley of the Nile, and Lower

the ages: EGYPT, Part 1

Egypt, the delta area—had been united under King Menes about 3400 B. C. Even in those early days, an expert in planning and construction emerged and was soon recognized. This man became the king's "chief of works," in short, a general construction expert. Later we note some specialization, such as "chief pyramid builder," but in modern terms the early "chief of works" was both a civil engineer and an architect, and also on occasion an expert on military facilities.

The engineering family of today is, on the one hand, the outgrowth of continued specialization, and on the other, of the bringing into the profession of other branches that have more or less independent histories as practical arts. Some of these also extend back to ancient times. Thus ancient Egypt has long been known as the "Mother of the Practical Arts," and the early chemical industries—glass making, dyeing, and cement making—were forerunners of modern chemical engineering, while the forerunners of the mining engineer engaged in primitive copper mining on the Sinai Peninsula.

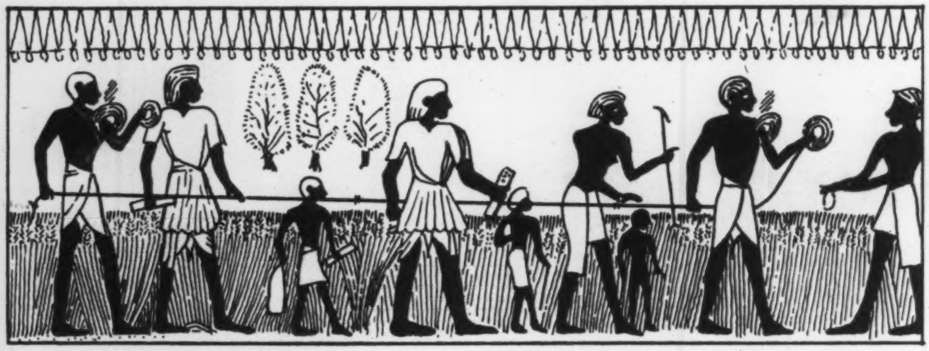
It is surprising to find that these ancient Egyptians used but three of the mechanical advantages known to the ancients—the inclined plane, the lever, and the roller. The first two were widely employed, the roller apparently but sparingly. The wheel appears only in a light form in chariots, while the screw and the pulley, even as a single sheave, seem to have been unknown. Many of our hand tools, such as bow drills and saws, were made and used widely. Surprisingly enough, no trace of a trowel has come down to us from this predominately masonry era.

Imhotep, father of masonry construction, was chief of works and trusted adviser of King Zoser. Also a sage and magician-physician, he became the Egyptian God of Healing. He built the King's tomb at Sakkara in 2980 B. C. This view of a later tiny bronze statue is from Kleinplastik der Egypter by Hedwig Fechheimer, Berlin, 1921.

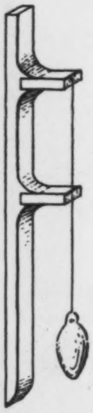
II. Imhotep, Father of Masonry Construction

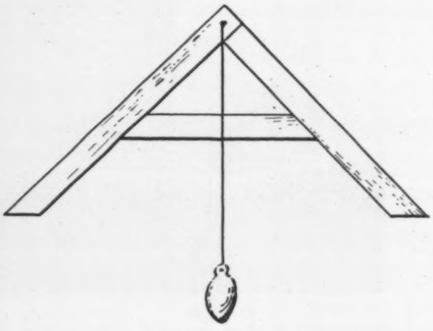
While rough stone work had been undertaken even before the First Dynasty of King Menes, and dressed stone appears at least as early as 3050 B.C., it was a master builder of some seventy years later who appears to have planned and directed the first extensive use of cut-stone masonry. It has been said that Imhotep is "the first figure of a physician to stand out clearly from the mists of antiquity." Similarly it might be said that he is the first forerunner of the modern engineer and architect of whose accomplishments we have evidence.

Imhotep—the name means "he who cometh in peace"—was in fact not only a top ranking government official, a chief priest, and "chief of all the works of the king," but also a magician-physician who achieved a reputation as a sage that endured for ages. He became the Egyptian God of Healing. Apparently he was the son of a master builder, Kanofer. Presumably he had the best training his times afforded and was distinguished for his character and personality as well as for his vast learning and practical abilities.



Survey party and officials using coiled "measuring rope" are portrayed in wall painting in tomb of a superintendent of the Middle Kingdom, about 2000 B.C. Head and rear chainmen are working under supervision of the Superintendent of Lands of the King. Note boy with extra tablets and sack.





Plummet level and leveling A-frame were used by Egyptian builders to control their masonry construction. These sketches are from models, now in Cairo museum, found in tomb of Sen-nehem, Master Builder of the XIXth Dynasty. After Petrie.

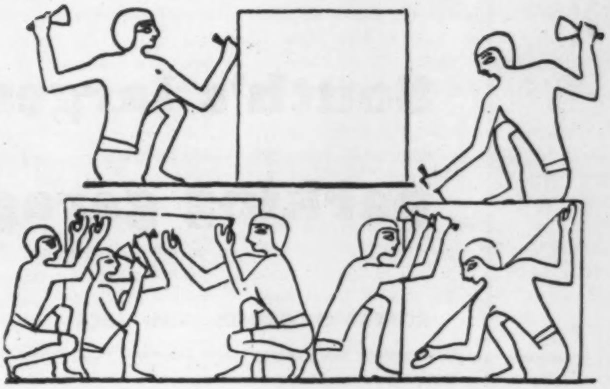
The first notable king of the Old Kingdom was Zoser, and for him about 2980 B. C. Imhotep built a wonderful stepped pyramid at Sakkara, near Memphis, with a rectangular base about 350 by 400 ft and about 200 ft high—the height of a modern 18-story building. See Fig. 1.

The first step in "above-ground" masonry construction seems to have been the so-called "mastaba" tomb, a flat-topped rectangular masonry-walled mass with sloping sides. Imhotep placed six of these low truncated pyramids on top of one another, in decreasing size, each from 30 to 40 ft high. Thus he constructed the world's first great masonry structure, which endures to the present day. This was the forerunner of the Great Pyramid which came 70 years later, for all that had to be done to reach the final form was to fill in the steps to provide plane sloping faces.

Imhotep used limestone for his stepped pyramid, and there seems no doubt that the stone was quarried and dressed by means of copper chisels although "bashing" with hard rocks was employed for harder stone and notably for granite. The quarries, both the open cut and underground workings, show that the stone blocks were cut by channeling around them and then loosening them from the bed with wedges. The narrow channel cuts, four to five inches wide, show marks similar to those made by a metal pick, and it is difficult to understand how such deep and narrow cuts could have been made with any other instrument. Yet no pick has been found. While tomb paintings and carvings illustrate all kinds of activities, from hunting and fishing to pottery making, there is a singular lack of representations of quarrying and construction operations.

Transportation appears to have been primarily by boat and sled, using earth embankments as temporary inclines. Such temporary inclines were used to raise the blocks into place instead of scaffolding, in the absence of timber and hoisting equipment. These ramps may have been held up in part by mud-brick retaining walls. It has been estimated that the Egyptian worker carrying earth in baskets could place one cubic yard in about two hours. A stream of, say, 500 men could thus place a remarkably large embankment in a few days or weeks.

Final dressing of stone masonry was usually carried out after the stones had been placed, using levers and temporary projections left on the rough face, or recesses cut into it. While bedding joints were kept approximately flat and horizontal, apparently efforts were seldom made to ensure that rising joints would always be at right angles either to the bed or to the face. Englebach conjectures that rough blocks were selected with approximately parallel end faces and set on line end to end with just enough space between to permit dressing of the ends to make them more or less parallel. Only such end and lower bedding joints were dressed in this way. The top bedding joints were finished by another group of workers after the stones had been placed. As previously noted, the face was likewise finished "in place," thus permitting more men to be employed at one time and saving time. The absence of "headers" is especially evident in Egyptian masonry.



Egyptian stone workers are seen testing whether face of a stone is plane by means of sighting string and pegs all of same length. Mallets are of a form still used today. After Newberry's "Life of Rekhmara."

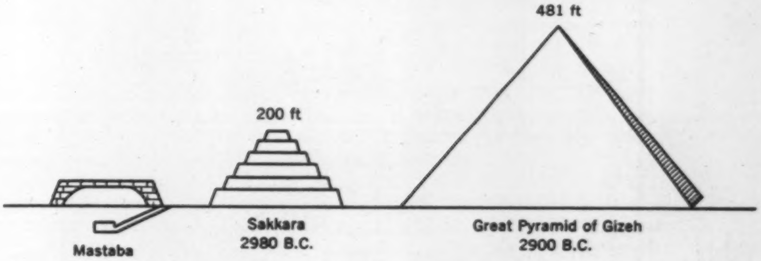


FIG. 1. Pyramid tomb evolved from a simple beginning in very brief period. Usual simple tomb of thirtieth century B. C. was the "mastaba" or sand heap covered with masonry. Imhotep placed six of these masonry units one on top of another to form truncated pyramid tomb for King Zoser near Memphis. Finally came Great Pyramid at Gizeh, built by Master Builder Khufu-onekh for King Khufu, in construction period of 20 years. In this period, 2¼ million cut stones weighing about 2½ tons each were placed.

III. Khufu-onekh, Master Builder of the Great Pyramid

While the joints of Imhotep's work were dressed for only a few inches back from the face and the rear joint was filled with a gypsum mortar and stone chips, the joining of the facing blocks of the Great Pyramid was accurate beyond belief. It is said to be impossible to put a knife blade between these huge blocks. The backing or core blocks are much rougher.

The Great Pyramid clearly involved a serious surveying problem for not only does it rise from an uneven bed but it covers a rock mound of unknown extent which prevented cross measurements. A number of "pyramid cranks" have attributed various remarkable relationships to its dimensions. From the point of view of surveying, it is clear that the observed accuracy was well within the powers of the builders, even with the simple measuring devices at their disposal. Orientation was by the Pole Star, and the base, some 750 ft on each side, appears to be accurate to within about 8 in., or 1 in 1,000. Egyptian measurements in land surveying were made by means of "a coil of rope," and such linear accuracy, while excellent, is not impossible. The ancient plummet level and leveling A-frame would appear to have provided the essential control for the sloping faces.

Herodotus tells us it took 100,000 men some 20 years to cut, transport, and place the estimated 2¼ million blocks in this huge pile, which covers over 13 acres and is 481 ft high. The average weight of each block is 2½ tons. Straub estimates that 200 man-days were required per cubic yard and remarks that this may not be too much of an exaggeration when all the labor involved in this entirely manpower job is considered. (See *A History of Civil Engineering,* London, Leonard Hill, 1952, p. 8.) Khufu-onekh was the master builder who organized and directed the building of this great monument to patience, labor, and organizing ability. His tomb is near his masterpiece.

Comparisons are difficult, but on the last great stone masonry structure built in the United States, the New Croton Dam (1892-1907) a maximum force of 851 men (475 on the dam and 376 in the quarries) were employed on the masonry. In the best month, June 1898, 17,186 cu yd were placed, which is at the rate of a bit over one 10-hour man-day per cu yd.

The several works of James H. Breasted, such as *Ancient Times, a History of the Ancient World* (Ginn and Company, New York, 1916) offer fascinating information on the birth of engineering and of civilization. There is still much uncertainty as to early dates and a wide variation in the spelling of names. We have followed Breasted in this article.

While there are numerous volumes dealing with ancient Egyptian works, *Ancient Egyptian Masonry* by Somers Clark and R. Engelbach (Oxford University Press, New York, 1930) provides a fascinating and authoritative summary by experts.

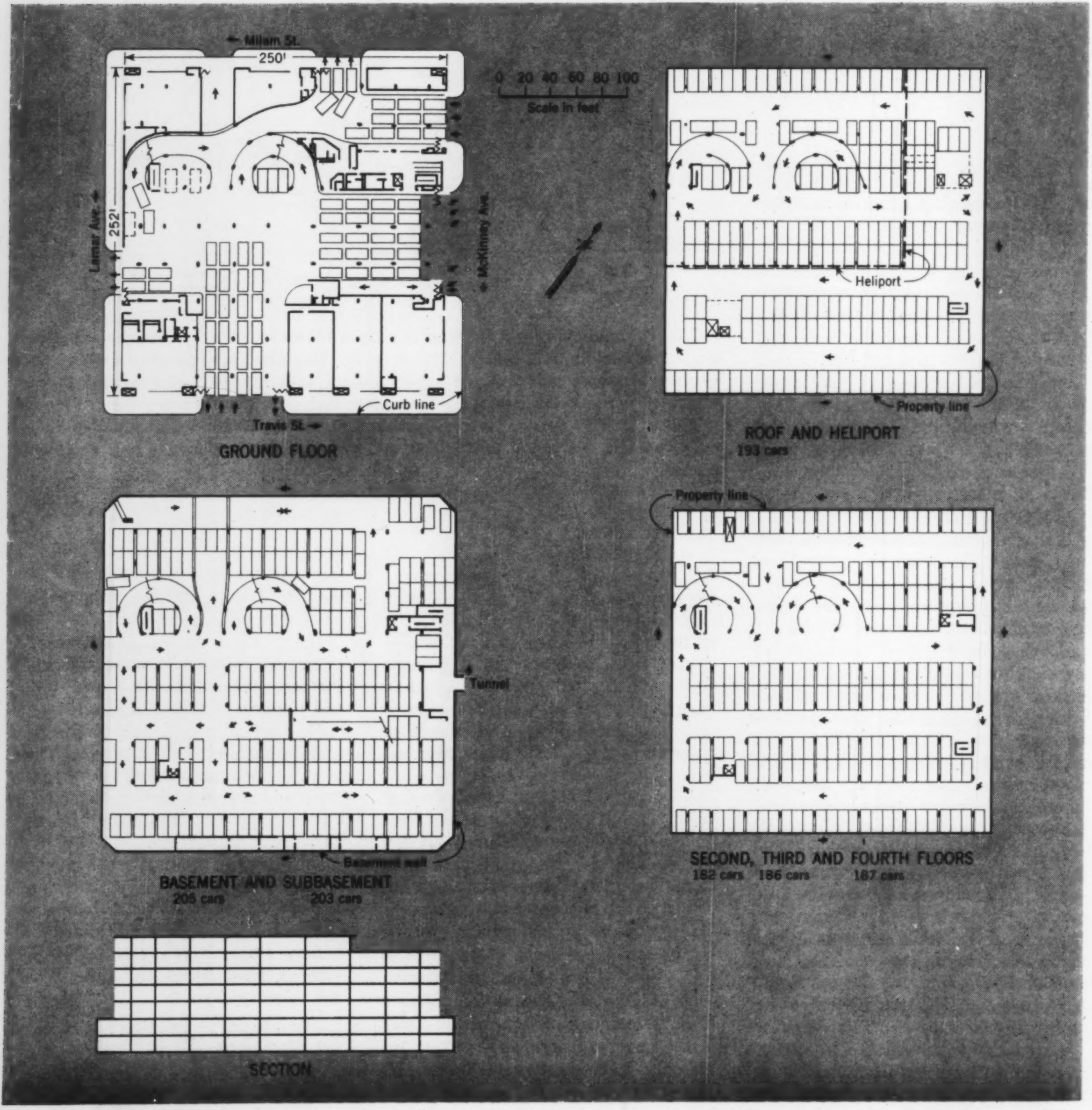
(Next in this series about our engineering forerunners will be sketches of the early Egyptian hydraulic expert, Uni, and of the obelisk makers, Ieni and Senmut.)

South's largest ramp-type parking garage completed

ROBERT O. GRIMES, A.M. ASCE

Associate and Senior Project Engineer, H. E. Bovay, Jr., Consulting Engineers, Houston, Tex.

FIG. 1. Ten Ten Garage in Houston, Tex.


Milam St.
250'
252'
Lamar Ave.
McKinney Ave.
Travis St.
Curb line
GROUND FLOOR
0 20 40 60 80 100
Scale in feet
Heliport
Property line
ROOF AND HELIPORT
193 cars
Tunnel
Basement wall
BASEMENT AND SUBBASEMENT
205 cars
203 cars
Property line
SECOND, THIRD AND FOURTH FLOORS
182 cars 186 cars 187 cars
SECTION

The Ten Ten Garage in Houston, Tex., was opened in June of 1956 by the Ten Ten Travis Corporation, a wholly owned subsidiary of the Tennessee Gas Transmission Company. It covers the entire block, which is bounded on the north by Lamar Avenue, on the south by McKinney Avenue, on the east by Travis Street, and on the west by Milam Street. This central location, one block west of Main Street, makes it easily accessible to the major office buildings, department stores, theaters, and shops of the downtown district. This facility, which cost approximately $3,000,000, has parking space for 1,500 cars, equivalent to about ten miles of curbside parking. Since accommodations are offered to both monthly contract parkers and short-time drop-in customers, the average-day parking load is about 3,000 cars.

Unusual services offered

This garage offers several unusual services. One of these is "desk-side" parking for tenants of the new 24-story Bank of the Southwest and the 22-story Tennessee Gas Commerce Building. This parking is provided by means of two air-conditioned tunnels under intervening McKinney Avenue and Travis Street. These tunnels, their walls decorated with attractive display windows and served by escalators, furnish tenants of these buildings a pleasant interlude in journeys to and from the garage. Another unusual feature is a complete repair service, which includes washing, lubricating, wheel alignment and balancing, motor tune-up, gasoline, mechanical repairs, and the sale of allied automotive equipment.

There are four parking levels above the ground floor and two below. The roof provides a heliport, the first in Houston, which is now used by Tennessee Gas as a part of its huge transportation system. The ground floor is used for receiving and delivery of cars, administrative offices, two cashiers' cages with adjoining lounges, waiting and rest rooms. The lounge and rest room areas are attractively furnished and completely air-conditioned for the comfort of waiting patrons. See Fig. 1.

The central location of the garage with the resulting heavy pedestrian traffic make its street frontage ideal for shops. To take advantage of this situation, seven shops are provided, each completely air-conditioned.

Intensive studies of traffic and parking patterns led the way in the planning of this garage. Thomas E. Willier, Houston traffic and business consultant, evaluated garage parking and future business potentials of downtown Houston and prepared the traffic design utilized in the operational plan of the garage. Further information, provided by the U. S. Bureau of Public Roads and the Department of Traffic and Transportation of Houston, was also used in the design of this facility. Comparison of potential parking demands with available parking space revealed a deficiency of approximately 4,000 parking spaces in the area served by the garage. The justification for its construction was based on this study.

After consideration of the above factors, a traffic design and plan for operations was prepared by Mr. Willier, the Ten Ten Travis Corporation officials, and the consulting engineering firm of H. E. Bovay, Jr., which coordinated the design of the project. At the same time, nearly every outstanding large garage in the United States was visited. Their operations and design were reviewed so that the best features of each could be incorporated in this structure.

It was decided to design the garage as a ramp-type structure. Full consideration was given to the mechanical aids for parking cars, but it was felt that a large part of the garage should be utilized by contract parkers who could park their own cars, and that most of the remainder of the garage could be converted to self-parking later. Therefore special consideration was devoted to the functional design of the ramps, aisles, and parking spaces so as to make the garage extremely easy to use.

Ramps were designed with generous radii and gradual slopes (below 10 percent in nearly all cases). Aisles are 22 ft wide, and parking spaces are 8 ft 6 in. wide by 20 ft long, except for special cases. Columns, spaced 18 ft to 35 ft apart, are oblong to allow maximum space for parking and are oriented in different directions on different floors to facilitate operations. Exterior columns are set back from the face of the building 14 to 15 ft. Normal headroom was set at 7 ft 6 in., with a normal story height of 9 ft 2 in., except at the first floor, where 12 ft 6 in. is the nominal height.

Reinforced concrete frame chosen

The superstructure of the garage is reinforced concrete joist-type construction (Fig. 2). Cost comparisons indicated that steel framing would be uneconomical because of the requirements of the City of Houston's Building Code concerning fire proofing. Cost comparisons with alternate reinforced concrete systems were favorable to that chosen because of the long spans and the generous cantilevers around the exterior of the building required by the functional plan of the garage.

Typical girder spans are 18 ft 6 in., 26 ft 10 in. and 35 ft 0 in., with the floors cantilevered over the outermost columns 15 ft 3 in. on two sides and 13 ft 8 in. on the other sides. Normally, the joist span is 29 ft 0 in. but spans up to 35 ft are used in certain areas.

The floor to floor height was set at

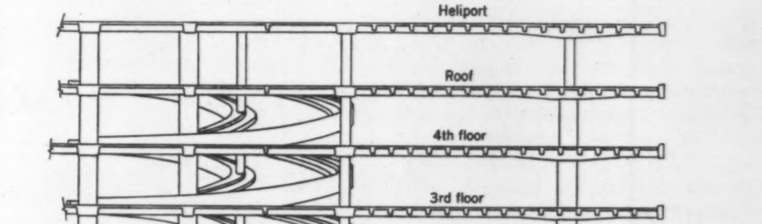


FIG. 2. In typical section through Ten Ten Garage, note floor, column and ramp system; cantilevered floors around perimeter of building (upper right); and ring of cast-in-place concrete piles around perimeter of basement (represented by one at lower right).

9 ft 2 in. because of the minimum height first determined from the standpoint of ramp grades, and the clear height of 7 ft 6 in. required for automobiles. This allowed 20 in. for the floor system with an additional 6 in. available near the columns outside the traffic lanes. This 20 in. allowed for the floor system had little effect on the joists as they are formed with metal pans 15 in. deep and 30 in. wide. Joists vary in width depending on span and load, and in certain areas their ends are thickened to handle shear stresses.

With this limited depth, the girders on the other hand required a width of 4 ft 8 in., with 6-in. haunches extending 6 ft 0 in. out from the column faces, and a high percentage of steel—200 lb per cu yd. The extra girder width acts as a haunch for the joist and was so considered in the design.

The columns vary in size, spacing, and orientation as determined by entrance and exit requirements on the first floor and the traffic and parking patterns elsewhere in the garage. A typical column is oblong shaped with flat sides and rounded, metal protected ends, tapering from 18 in. by 54 in. in the basement to a round column of 18-in. diameter beneath the roof. Because of the unsymmetrical frame and the extreme stiffness of the columns, the moment distribution was analyzed at key points throughout the structural frames.

The combination of unequal spans, cantilever moments, shallow girders and low story heights created a set of structural design conditions in which the columns were in some cases three times as stiff as the girders. Calculations involving dimensions and reinforcement of columns and girders therefore became tedious since only a few of the rigid frames were similar. Standard sizes were adopted for columns, and curves were prepared showing allowable bending moments with various percentages of steel, in accordance with the ACI code. These features facilitated the computations.

Although it would probably have reduced the cost of the structure and the amount of computation and engineering detailing, if equal or symmetrical framing had been adopted, the framework costs were surprisingly low—about $2.75 per square ft—and the functional aspects of the garage were of course enhanced considerably. An interesting feature of the design is that the main axis of a number of the oblong columns between the first and second floors are at right angles to those immediately above and below them. The transition required the special reinforcement and deep column capitals shown in Fig. 3.

The spiral ramps were designed as slabs reinforced one way, supported at their ends by curved girders. At some locations, where intermediate columns could not be provided, these curved girders have 40-ft spans. They were designed for the indicated combinations of bending and torsion. Two special straight-line ramps connect McKinney Avenue and Milam Street with the basement levels.

Foundation conditions

Foundation design was based on soil reports showing a very stiff red clay extending to a depth of 25 ft. This stratum was underlaid by silty, clayey sand varying in thickness from 4.5 to 14 ft. The water table at the time was

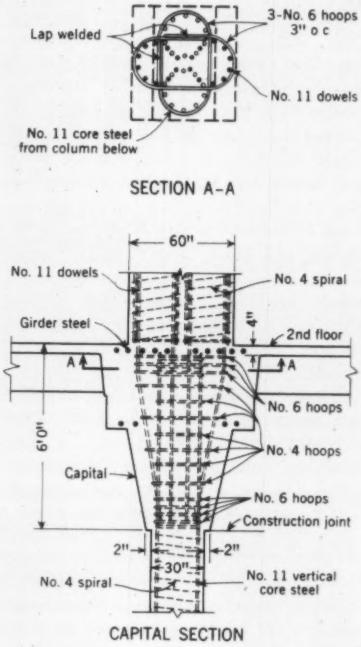

Lap welded
3-No. 6 hoops 3" o c
No. 11 dowels
No. 11 core steel from column below
SECTION A-A
60"
No. 11 dowels
No. 4 spiral
Girder steel
4"
2nd floor
A
A
No. 6 hoops
6'0"
No. 4 hoops
Capital
No. 6 hoops
Construction joint
2"
2"
30"
No. 4 spiral
No. 11 vertical core steel
CAPITAL SECTION

FIG. 3. Detail of column capital shows how direction of elongation of columns is changed at floor line.

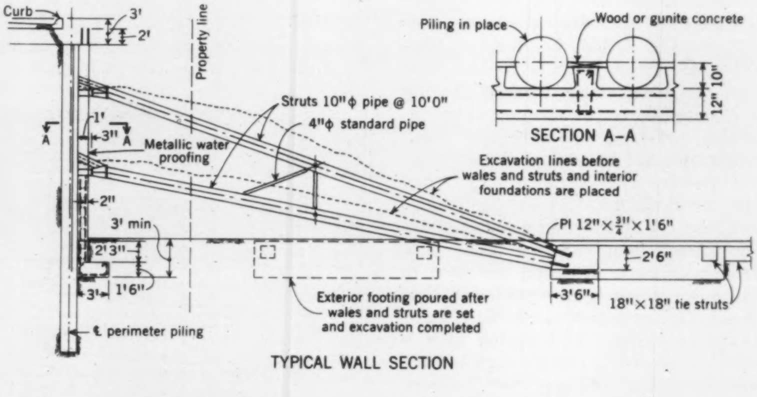

Curb
3'
2'
Property line
1'
3"
A
A
Metallic water proofing
2"
3' min
2'3"
3'
1'6"
℄ perimeter piling
Struts 10"ϕ pipe @ 10'0"
4"ϕ standard pipe
Excavation lines before wales and struts and interior foundations are placed
Pl 12"×¾"×1'6"
2'6"
3'6"
18"×18" tie struts
Exterior footing poured after wales and struts are set and excavation completed
Piling in place
Wood or gunite concrete
12"
10"
SECTION A-A
TYPICAL WALL SECTION

FIG. 4. Row of concrete piles around perimeter of basement excavation was braced temporarily by pipe struts, until concrete wall and basement floors could be poured.

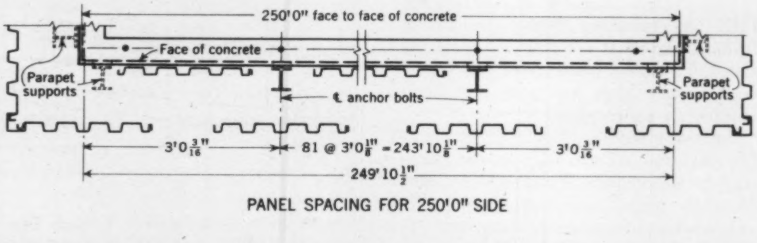

250'0" face to face of concrete
Face of concrete
Parapet supports
℄ anchor bolts
Parapet supports
3'0 3/16"
81 @ 3'0⅛" = 243'10⅛"
3'0 3/16"
249'10½"
PANEL SPACING FOR 250'0" SIDE

FIG. 5. Garage "skin" consists of overlapping aluminum panels baffled to allow free circulation of air while excluding the elements and direct sunlight.

at a depth of 30 ft. Below were alternating layers of clay, sandy clay, and silty sand. Footing depths at 23 and 25 ft required footings proportioned on the basis of the shear strength of the sand. A bearing structure of 5,000 lb per sq ft was used in foundation design with a safety factor of 2.

The predominating clay soils allowed the use of drilled and cast-in-place concrete piles around the perimeter of the excavation to act as sheeting. The piles were of 20-in. diameter, spaced 31 in. on centers, and 33 to 38 ft long. One third of the pile length was below the bottom of the excavation. After mass excavation was completed, a 12-in. concrete wall was poured along the piles to form the basement walls (Fig. 4). Steel walers and sloping struts anchored to footings provided temporary lateral support. The clayey sand-bearing strata, with low cohesive values, required horizontal thrust beams across the entire basement to resist the lateral thrust imposed on the footings from the struts.

Concrete of 3,000-psi strength was used in all foundations, while that of 4,000 psi was used in the superstructure to reduce the size and dead load of the members. Live loads are 75 psf for garage use and 100 psf for public areas, sidewalks, stairs, etc. The heliport was designed to resist a load of 5,000 lb concentrated on any one square foot, or a uniform load of 75 psf, whichever produced the higher stress.

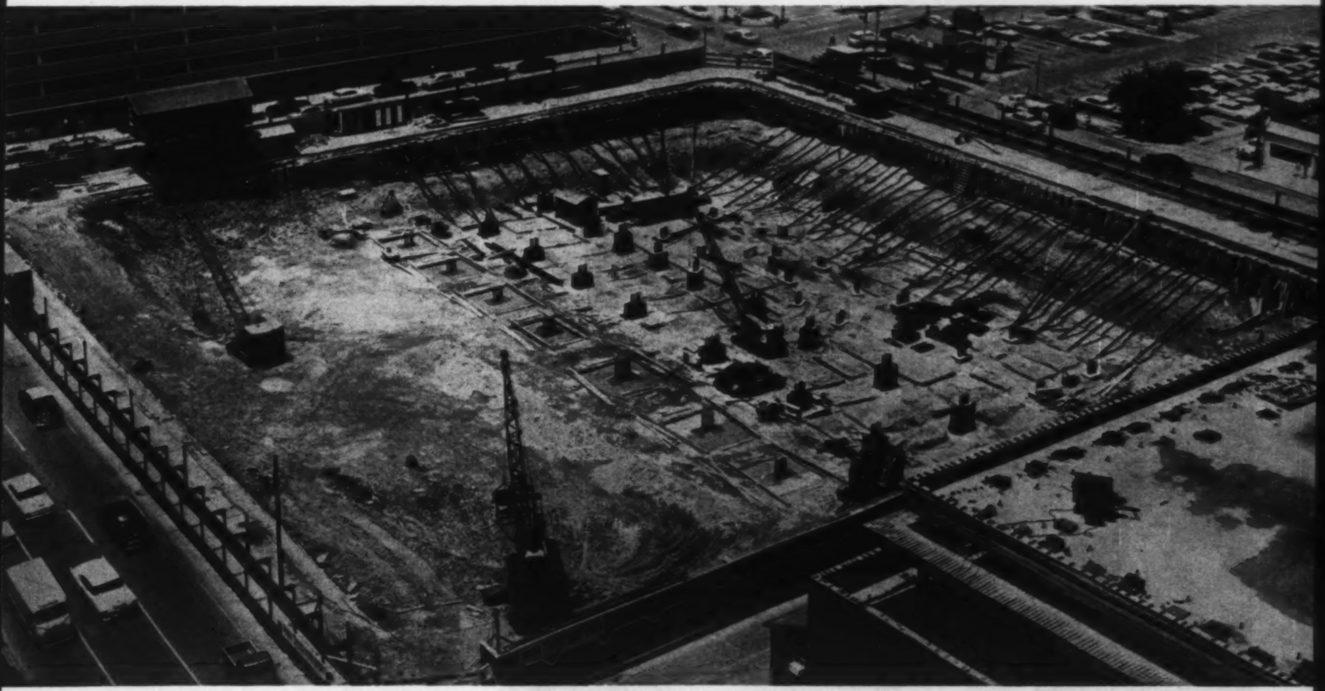
Careful attention to appearance

Architectural treatment of the building was efficiently handled by the consulting architects, Cowell & Neuhaus. An unusual feature is the exterior wall which consists of vertical sheets of fluted, alumilited aluminum decking of H. H. Robertson Co. The sheets extend from the sidewalk canopy to the roof parapet, staggered in a louver arrangement (Fig. 5) to provide ventilation while excluding rain and water spray from nearby cooling towers. Gray aluminum panels, 2 ft wide and attached to the face of the concrete spandrel beams, are spaced on 3-ft centers around the building perimeter. Staggered in front of them are alumilited panels 2 ft wide centered on the open spaces. This arrangement appears to be a solid wall of contrasting aluminum panels yet at the same time effectively carries out the functional requirements at really low cost. The architectural appearance is pleasing.

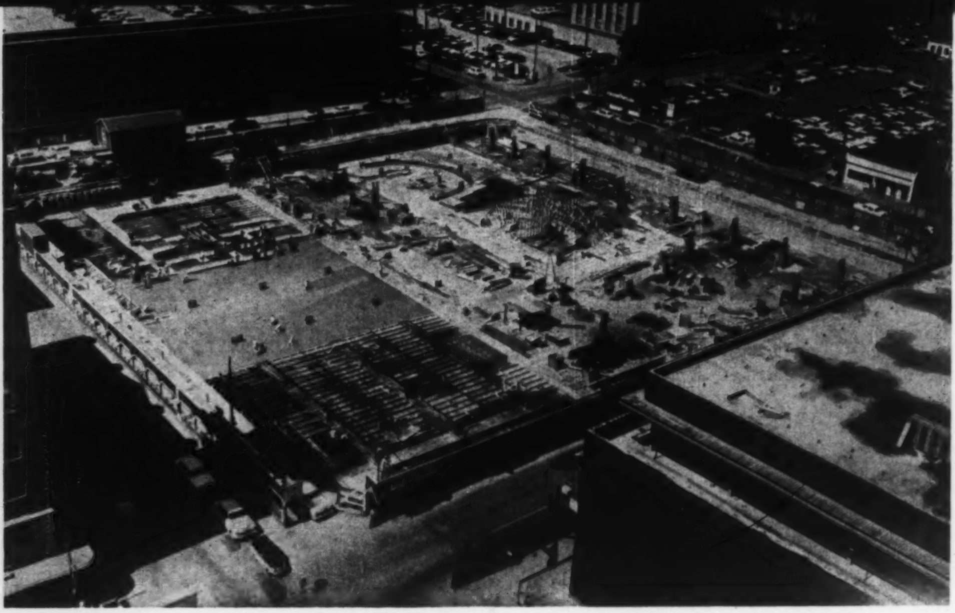
A special architectural study was devoted to the appearance of the ground floor and other public passageways. Each of the air-conditioned waiting rooms has terrazzo floors, glazed structural-tile walls and ceiling-high plate glass overlooking the car delivery reservoirs. It has been noted that these features are especially popular with the ladies who use the garage.

Each waiting room is equipped with a manually operated high-speed elevator. Provisions have been made for the installation of two additional elevators when the garage becomes completely self-parking. Four stair towers, finished with glazed tile, provide additional means for pedestrian movement. Two man-lifts and two slide poles allow attendants to move quickly throughout the garage. In order to enable customers to pick up their cars at either of the waiting rooms, an intercommunication system and a pneumatic-tube system are used.

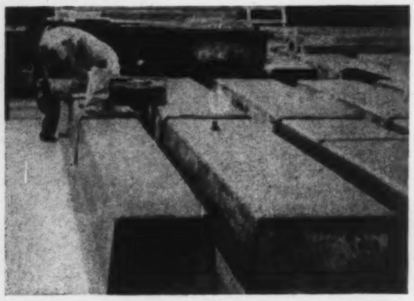
Among the mechanical features is a



Before excavation began, ring of concrete piles was installed around perimeter of basement. These drilled and cast-in-place piles are of 20-in. diameter, 33 to 38 ft long. As excavation deepened, a system of braced 10-in. pipe struts was set to brace the piles temporarily. Concrete thrust beams running across bottom of excavation in both directions were later installed to take thrust between spread footings, some of which can be seen in this view.



On far side of excavation, note reinforced concrete wall which has been poured against exposed piles. Forms for spiral ramps take shape, and at near corner, pans for ground-floor slab are being set.



Pan forms for floor system are shown in place at connection of joist to beams and girders.

Finished heliport slab occupies about one quarter of roof. Vertical sheets of aluminum are staggered to form louvered exterior wall. Space on roof will also be utilized for parking.

forced-air duct system that provides complete perimeter ventilation of the two basement levels. Ducts are hung from the ceiling and shaped to give maximum headroom. Outside air is taken in at the four corners of the second-floor level. Two fans at each corner feed into a single duct. Normally, one fan will be used, but at peak traffic periods both will be utilized to provide proper ventilation. Controls are located in the building superintendent's office in the basement.

The ventilation system is designed on the basis of 1 cu ft per min per sq ft of floor space. The outlet grills force air in a sweeping effect to the floor, where it is exhausted through the four ramps leaving the basement. Provisions have been made in the washmobile areas to exhaust the air so that humid air will not filtrate into adjoining areas. Also, the service area has an underfloor exhaust system with flexible hoses for clamping to the tail pipes of cars being serviced. Space heaters in the service areas provide comfort for personnel.

Air-conditioners spaced throughout the garage have electronic controls to maintain a constant temperature. This is a desirable feature in view of the fluctuating load conditions.

In consideration of the garage's self-parking arrangement, special attention was given to lighting. The ground floor is provided with 40 ft-candle illumination, and the painted ceiling increases the light intensity. Other intensities vary from 20 on the ramps, 15 in the driveways and aisles, to 5 ft-candles in parking areas.

General contractor for the garage was the Manhattan Construction Company of Texas. Carl Myers is president of the Ten Ten Travis Corporation.

FOUR-YEAR ENGINEERING CURRICULA NOT SUFFICIENT

SAMUEL B. FOLK, M. ASCE

Professor of Engineering Mechanics, The Ohio State University, Columbus, Ohio

The question of the four-year versus the five-year college engineering curricula has been argued energetically for some time. In favor of the former, the argument has been advanced that, even after a five-year program, the young engineering graduate is still not "fully ready" to discharge his professional duties. Also, many may need to start making a living after four years and, if they can "barely afford four years," are "likely to become a plumber or an electrician, consoled by the high starting salaries" rather than to undertake the burden of a five-year course. These quotations are from the article by E. R. Harrington, A.M.ASCE, in CIVIL ENGINEERING for June 1956.

These arguments, it seems to me, overlook what has happened to scientific education in recent decades, and the need to bring the engineer up to full professional status. Because of the vast amount of new knowledge that must now be crowded into the curricula, all other professions have lengthened their college programs. Typical patterns follow:

	PREREQUISITE	PROFESSIONAL
Medicine	3 years	4 years
Dentistry	2 years	4 years
Law	3 years	3 years
Optometry	2 years	3 years
Vet. Medicine	2 years	4 years
Pharmacy	2 years	3 years

Many students in these programs have had more than the two or three years required before entering. For instance, only 40 percent of those entering veterinary medicine at one institution had as little as two years of preprofessional college work. These also may be poor hard-working young men anxious to make a living. All these professions have reaped advantages from lengthened curricula, while engineering colleges continue to enroll the stupid and the uninspired along with the able high school graduate. Course standards are set for the average boy, resulting in training for mediocrity.

As President James R. Killian of Massachusetts Institute of Technology said in his Sigma Xi address (December 27, 1955, published in *American Scientist*, April 1956), we have "a shortage of intellectual talent adequately educated and in the right place. . . . Employers are not looking for 'bodies' with degrees; they are looking with a critical eye for very special qualifications—for a sound education in fundamentals, for analytical power, for a grasp of the new and advanced fields of technology. They are looking less for specialized competence at the baccalaureate level and more for men who have the versatility to follow successfully any one of several specialities."

According to the *Journal of Engineering Education* (April 1956, p. 678), the four-year curriculum exists more frequently on paper than in fact. Although few engineering schools advertise a five-year program, many require more than four years, "since a majority of their students must either make up prerequisites before starting their engineering programs, or must take extra semesters to complete courses failed or coming out of sequence."

Since the great mass of prospective engineers graduating from high school are not adequately prepared, it would seem wiser to adopt a pattern like that of other professional schools, that is, to require two years of pre-engineering in colleges of liberal arts followed by three years of really professional work. As in other professions, certain specific courses, such as mathematics, physics, chemistry, English, history, drawing, physical education, combined with definite levels of scholastic attainment, could be required for entrance to a professional engineering college.

A number of advantages would accrue from such a program:

1. Engineering colleges could be operated more efficiently since only qualified students could enter. Fewer failures would result.

2. Capable high school graduates who lack such courses as advanced algebra (because their high school is too small to offer them) would not be discouraged by being placed in "sub-freshmen courses." Students entering engineering would have a stimulus to qualify for entrance to the professional school.

3. Engineers who graduate from this program would be more valuable to industry and government, and command higher salaries. Ours being a culture in which monetary rewards are important, this should have the effect of recruiting more students. Consider a few pertinent data from "The Class of '46 Looks at Itself," by Samuel W. Mathews and Richard D. Schwartz (*The New York Times Magazine*, June 10, 1956). The average annual salary of the 124 Yale men who majored in engineering and graduated in 1946 was, ten years later, $7,351, while the average of all 537 members of the class was $7,575. Compare this with the 29 graduates in manufacturing ($9,052), the 14 in advertising ($8,268), and the 75 in sales ($8,507). Engineers ten years out of college ought to come up to the average for the class.

4. Administrators of our universities would become conscious of the professional attitude of the engineering faculty and be compelled to offer them higher salaries to attract competent scientists and researchers. As Dr. Arthur S. Flemming, Director of the Office of Defense Mobilization, says, "Our salary scales for teachers, with some exceptions, are a disgrace. Teachers do not expect to become wealthy. They desire to serve. Society should not, however, deliberately penalize them and their families because of their willingness to serve" ("Nation's Interest in Scientists and Engineers," *Scientific Monthly*, June 1956).

5. After an intensive pre-engineering program, the professional curriculum would provide a better foundation for graduate work. In comparison with the other professions, the number of students going on into advanced study in engineering seems too small for the general welfare of the nation. The new advancing technologies such as aerodynamics, energy conversion, nuclear engineering, servo-mechanisms, and metallurgy call for graduate work.

Only by studying our deficiencies and working to improve our educational system can we bring our engineering colleges up to the standards of truly professional schools. Our universities can never turn out "finished engineers" in four or five years. But they can do a better job in five years than in four. The sooner our engineering societies get behind the movement to put engineering education on a truly professional basis, the sooner our universities will make the needed changes, and their engineering graduates will begin to reap the professional and financial status they deserve.

AUTO MANUFACTURING PLANT

Argentina is a country of relatively few paved roads as compared with the United States. It is a country which has been chronically short of automotive transportation and which has had to import all its automobiles and trucks. The Argentine Government has been desirous of establishing an automobile manufacturing plant within the country, primarily for the production of vehicles to meet the needs of rural areas.

To implement this need, Industrias Kaiser Argentina (IKA) and Industrias Aeronauticas y Mecanicas del Estado (IAME), a manufacturing and air flight training branch of the Argentine Government, agreed to construct an automotive manufacturing plant in Argentina. IKA was formed as a result of an agreement between Kaiser Motors Corp. (now Kaiser Industries) and IAME. Kaiser Motors Corp. agreed to furnish the necessary heavy machinery as well as technical direction for a sufficient time to train Argentine personnel to operate the plant. IAME agreed to furnish some of the smaller machinery as well as a part of the capital required. Additional capital was obtained by the sale of stock to the public.

In January 1955, IKA employed Kaiser Engineers International, Inc., a subsidiary of Kaiser Engineers of Oakland, Calif., to design and construct the plant. A team of civil engineers and a purchasing agent proceeded at once to Argentina to select a suitable site and to initiate design work. From these early beginnings, maximum use was made of Argentine contractors and other personnel as well as of Argentine materials in so far as feasible.

Several cities had been considered for possible plant sites, including Buenos Aires and Cordoba. The crowded condition of the capital and the cost of possible plant sites there, the desire of the Argentine Government to locate some manufacturing in smaller cities, and especially the availability of power and a trained labor force in Cordoba, resulted in the selection of the latter city. This city of some half million population is located in a valley adjacent to a small river and at an average elevation of 1,500 ft above sea level. The plant site selected was about six miles from the center of town. In March 1955, only 40 days after the engineering planning group first arrived in Buenos Aires, construction started.

Local conditions determined design

The plant has a total covered area of 72,340 sq meters (778,660 sq ft). See Fig. 1. It is constructed of reinforced concrete footings and columns and of structural steel, with the outside walls and many of the inside walls of brick and plaster. Since portland cement as well as reinforcing steel and form lumber is quite scarce in Argentina, wherever possible brick and plaster is used instead of concrete. Another factor that entered into the choice of brick-plaster wall construction was the lack of adequate handling equipment. A third factor was economy.

In Argentina brick masons and plasterers earn practically the same as other skilled crafts or "oficiales," an average of about 15 pesos an hour ($0.42), plus about 40 percent in direct fringe benefits. In comparison, peons or unskilled labor average about 8 pesos an hour, plus fringe benefits. Brick is fairly cheap as brick kilns are numerous. All a brick manufacturer needs is a small plot of ground, a little straw for binding, and a donkey to walk around in the mud mixture for a day or so. After this the bricks are formed, dried in the sun, and then fired with wood. These bricks will not withstand excessive heat but a large percentage of the houses in Argentina—at least in the vicinity of Cordoba—are of this brick-plaster construction.

For the automobile factory, the brick walls were built with a concrete bond beam at the point where the brick ends and windows and corrugated aluminum sheeting begin. One of the most diverting sights on the construction was to see a bond beam being poured. The workmen filled 2-gal buckets with concrete and passed them from hand to hand to the beam at the top of the brick wall 5 meters (16 ft 5 in.) above floor level.

Concrete was mixed without air-entraining agents in a central mixing plant and transferred to the site in dump trucks. A few revolving mixing trucks are available in Argentina but the cost was prohibitive for the Cordoba construction.

Proportioning at the central mixing plant was all volumetric, the measurements being made by workmen shoveling aggregates into wheelbarrows and dumping into the mixer, which was below ground level. In spite of the pouring methods employed, fairly good concrete was obtained. When poor concrete did occur, it was largely due to faulty vibration since machine vibrators were very scarce.

Curing, another interesting feature

Curing is another interesting feature of Argentine concrete construction. When horizontal slabs or pavements are poured, curing is done by letting water stand on the concrete. Workmen construct earth dikes to retain the water, and after the curing period the dikes are removed. All the work is done by hand shovel and wheelbarrows, and consequently it is sometimes difficult to obtain a properly cured column or beam, or any above-ground structure.

Slip-form methods were used to construct the reinforced concrete water tower. This structure was cured by means of a wax compound, which was located after an extensive search.

Tile roofs are the cheapest type available in Argentina, and they are used on practically all the houses. However, for reasons of weight and the weight of the necessary supporting structure, corrugated aluminum was used for the factory roof instead of tile.

Press-plant construction and the erection of the heavy presses presented

built in Argentina

WRIGHT M. PRICE, M. ASCE

Construction Engineer, Kaiser Engineers International, Inc., Cordoba, Argentina

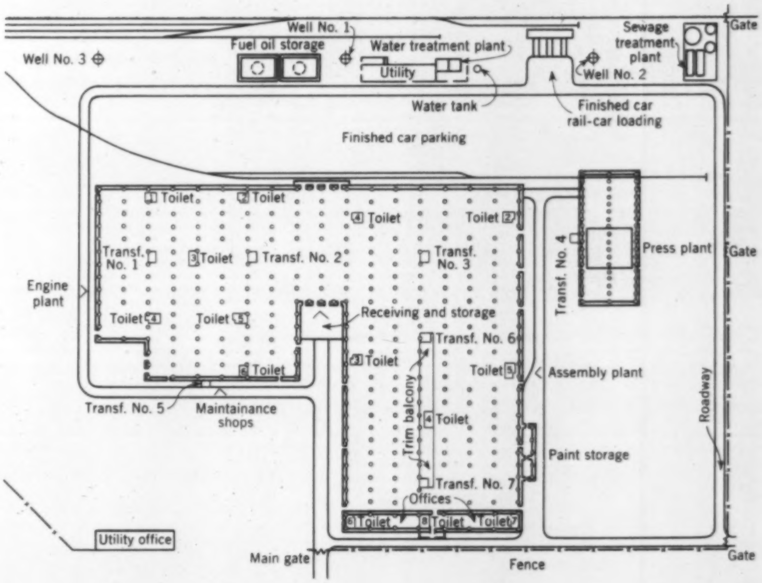
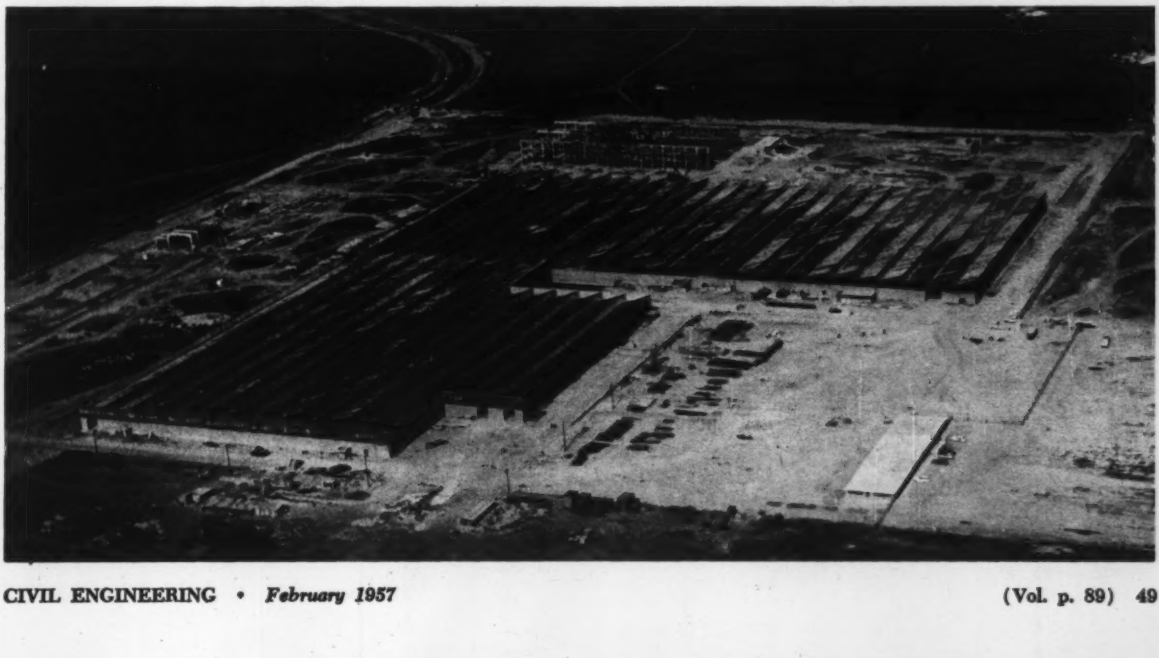

Well No. 1
Fuel oil storage
Water treatment plant
Sewage treatment plant
Gate
Well No. 3
Utility
Well No. 2
Water tank
Finished car rail-car loading
Finished car parking
Toilet
Transf. No. 1
Toilet
Transf. No. 2
Transf. No. 3
Transf. No. 4
Press plant
Gate
Engine plant
Receiving and storage
Transf. No. 6
Assembly plant
Roadway
Trim balcony
Paint storage
Transf. No. 7
Offices
Transf. No. 5
Maintainance shops
Utility office
Main gate
Fence
Gate

FIG. 1. First-floor plan shows layout of automobile manufacturing plant in Cordoba, Argentina.



Aerial view below shows status of construction in December 1955. Work was started in March 1955. Engine plant, warehouse, and assembly plant are all under one roof. Press plant is in upper center of photo, and at left center, construction has just started on utility plant. Railroad spur leads off at upper left.

Crown of one of the presses, a piece weighing about 70 tons, is being erected entirely by hand-operated winches. Workman on top is moving piece horizontally. Timber cribbing under crown is maintained as insurance against failure of lifting apparatus.

some difficulties which were overcome by perseverance and the use of a large working force. Truck cranes with a capacity of more than a few tons were practically non-existent. This lack of power-machinery handling equipment necessitated the use of gantry cranes equipped with hand-operated winches. In one instance, 24 men working hand-operated winches were required to lift one of the heavy press parts. After the columns and runways for the press-plant cranes were built, press parts weighing up to 50 tons were erected by overhead cranes, but the heavier parts were still handled by the "caballete," a form of gantry crane.

All of the structural steel roof structure was erected by hand-operated winches and booms. The contractors who performed this work were two of the leading steel fabrication and erection firms in Argentina. Construction personnel deserve credit for their excellent work using their own methods of construction.

Concrete columns instead of steel columns were used because the heavier steel sections required for the relatively light columns are not rolled in Argentina. The dollars required for the importation of these heavier sections from the United States or Japan are not available except in cases of extreme necessity.

Since the plant is situated outside the city of Cordoba, water is not obtainable from city mains. Wells had to be installed to obtain a sufficient and potable water supply. A well drilling contractor reported that water could be found at a depth of 40 meters (130 ft), in a gravel bearing strata at 140 meters (450 ft), and in abundant supply at a depth of 170 to 180 meters (560 to 590 ft). Three wells were drilled to a depth of 175 meters (575 ft), each capable of producing about 40 cu m (about 10,000 gal) per hour. However, these are artesian wells and the piezometric surface is only 40 to 60 meters (130 to 195 ft) below ground level. The cost of the well drilling, including the steel pipe lining of 8, 6 and 4 in., was 140,000 pesos or $4,667 for each well. Drilling required the services of an operator and helper, plus equipment, for a period of three months for each well.

Sink hole or "mallin" occurred close to plant. This phenomenon of the region extends to depth of many meters and absorbs all runoff, even during heavy rains. Its course extends underground to right of pipe in background and then to left for some distance.

Sink hole poses problem

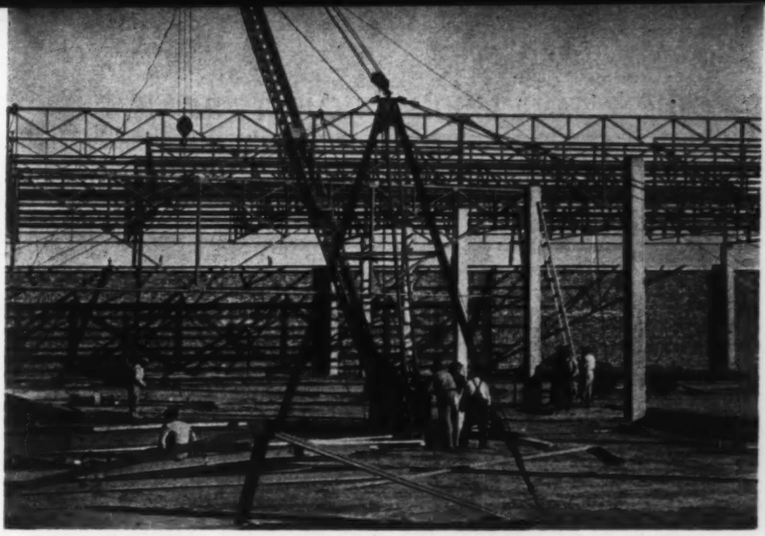
Another problem met with was a sink hole or *mallín* alongside the railroad spur. The *mallín* is an erosion phenomenon typical of the Cordoba zone, consisting of a very deep crack in the earth which generally reaches down to the first water table 20 to 40 meters (65 to 130 ft) below the ground level. It is dry all winter, when there is practically no rain. The *mallín* appears on low zones, and enormous quantities of water disappear through it. In our case the *mallín* absorbed all the storm water drainage from the plant, in one instance amounting to three days of constant rain. Logically, the abundance of water running into this area deepened the initial crack, producing deep trenches that damaged the railroad fill. Because this sink hole is so many meters deep and of a length that can be more than one kilometer, it is practically impossible to fill. On our job the *mallín* was covered superficially with a lean concrete mixture and the rain drainage was passed through concrete pipes for a length of 60 meters (200 ft) on both sides of the railroad spur above the *mallín*.

After some 17 months of work, personnel of Kaiser Engineers Argentine, with the aid of the very efficient and able technical help of IKA operating personnel and some 50 Argentine contractors, have constructed approximately 95 percent of the plant. On completion, this plant will be able to fabricate 40,000 units annually, made up largely of jeeps, pickups, and station wagons, but including some passenger cars. Almost 100 percent of the material used in plant construction is of Argentine manufacture, excluding the fabricating machinery installed in the plant.

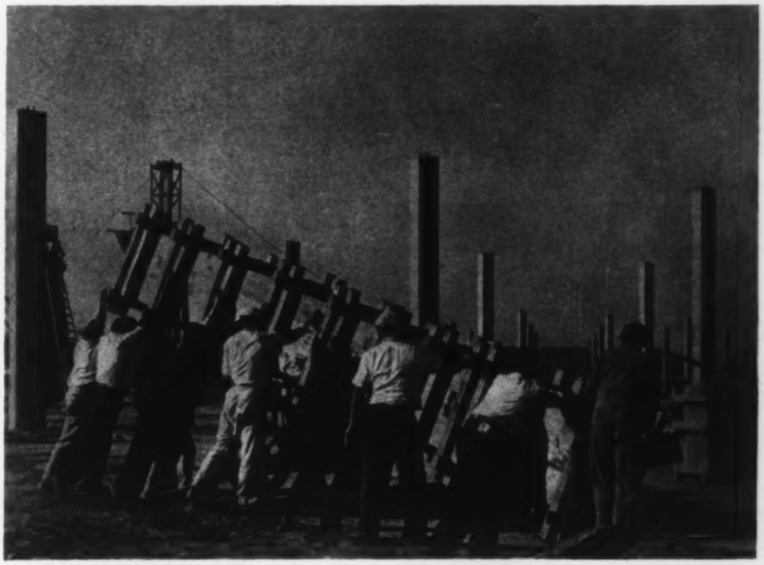
The first 10 jeeps were produced in April 1956, and each month thereafter production has increased. As of December, some 2,400 units have come off the fabricating line. For the first few thousand units that are to be fabricated here, many of the parts, such as the rough engine castings, axles, frames, and transmissions—approximately 40 percent of the entire units—will come from the United States. As more units are fabricated and as manufacturing and assembly lines become complete, it is estimated that virtually 100 percent of the parts will be of Argentine manufacture for assembly in the Cordoba plant.

A large amount of credit must be given to the Argentine contractors and to the efficiency of their personnel within the framework of their limitations. If the Argentine worker is given tools, opportunity, and some training, he can equal the skill and speed of construction workers in any country in the world.

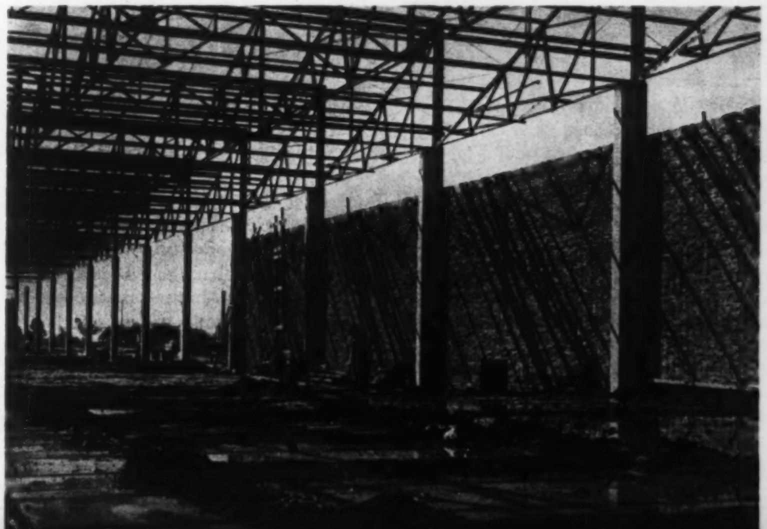
The automobile plant at Cordoba is owned by Industrias Kaiser Argentina, Buenos Aires. James F. McCloud is general manager and Kenneth F. Flood is works manager.



Structural steel is being erected by hand-operated booms. Men in center operate hook while swing of boom is controlled by men to right of center.



Workmen raise form for prefabricated column into place. This method was found more economical than erection by a boom or stiff-leg. In view below, floor slab in engine plant is cured by letting water stand on it. Earth dikes surround slabs to keep water in place.



CARQUINEZ TOLL BRIDGE PROJECT – Part II

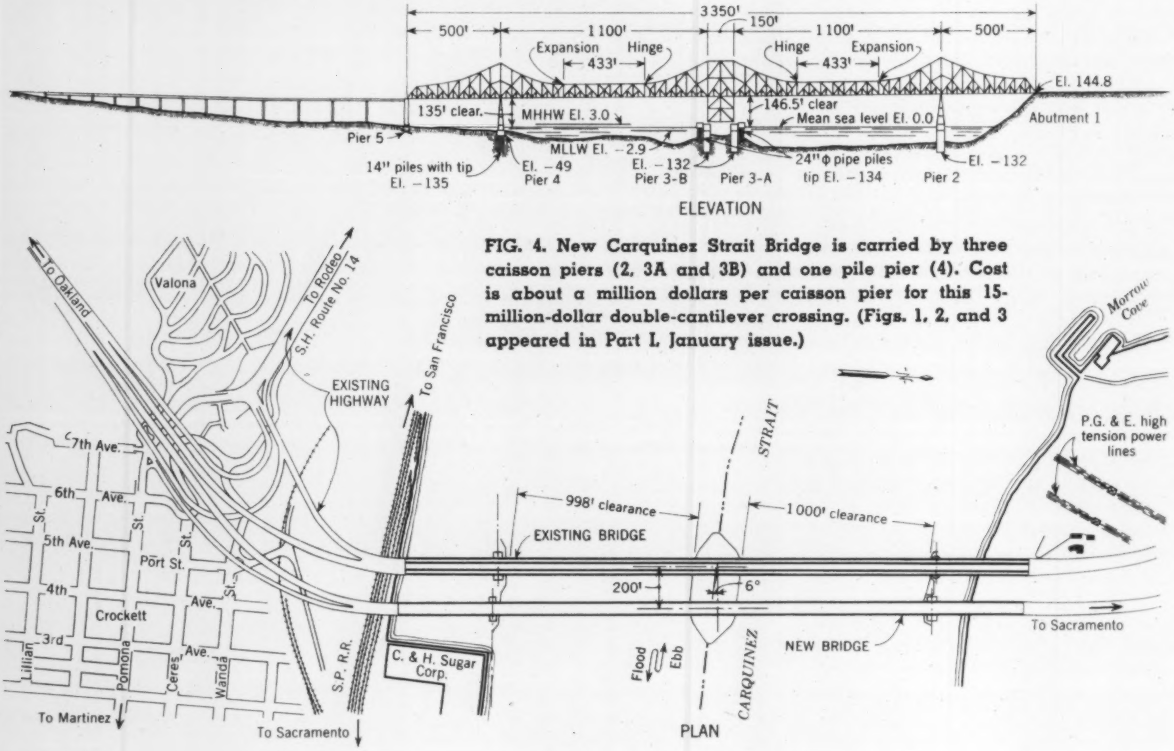

3350'
500'
1100'
150'
1100'
500'
Expansion
Hinge
433'
Hinge
Expansion
433'
El. 144.8
135' clear.
MHHW El. 3.0
146.5' clear
Mean sea level El. 0.0
Abutment 1
Pier 5
MLLW El. -2.9
14" piles with tip El. -135
El. -49
Pier 4
El. -132
Pier 3-B
Pier 3-A
24" ϕ pipe piles tip El. -134
Pier 2
El. -132
ELEVATION
To Oakland
Valona
To Rodeo S.H. Route No. 14
To San Francisco
EXISTING HIGHWAY
Morrow Cove
P.G. & E. high tension power lines
STRAIT
7th Ave.
6th Ave.
5th Ave.
Port St.
4th
Ave.
Crockett
3rd
Ave.
St.
St.
St.
St.
Lillian
Pomona
Ceres
Wanda
998' clearance
EXISTING BRIDGE
1000' clearance
200'
6°
To Sacramento
NEW BRIDGE
S.P. R.R.
C. & H. Sugar Corp.
Flood
Ebb
CARQUINEZ
To Martinez
To Sacramento
PLAN

FIG. 4. New Carquinez Strait Bridge is carried by three caisson piers (2, 3A and 3B) and one pile pier (4). Cost is about a million dollars per caisson pier for this 15-million-dollar double-cantilever crossing. (Figs. 1, 2, and 3 appeared in Part I, January issue.)

Bridge features deep-bottom caisson and high-strength weldable steel superstructure

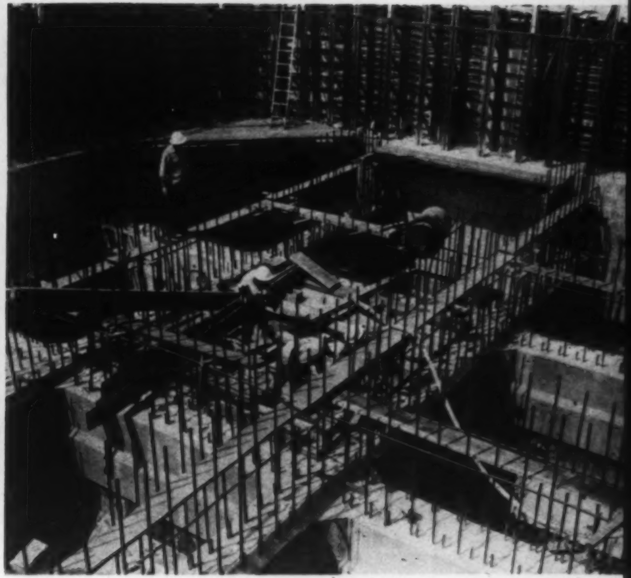
LEONARD C. HOLLISTER, M. ASCE

Project Engineer, Carquinez, California Division of Highways, Carquinez, Calif.

In Part I of this article, which appeared in the January issue, Mr. Hollister described the construction of the new 3-mile south approach to the Carquinez Bridge. This work includes the moving of 11 million cu yd in cuts and fills and the erection, by slip-form, of 47 viaduct piers ranging in height up to 123 ft. In the present article he describes the new bridge itself, the piers for which are now under construction.

Substructure work is now under way for the new bridge paralleling the existing structure across Carquinez Strait. This work involves the construction of an anchorage abutment set in a shale and sandstone cliff at the north end of the bridge to support one end of the 500-ft north anchor truss span; three caisson piers founded on bedrock about 132 ft below water level; one cofferdam-type pier supported on 240 eighty-ton steel bearing piles; and an anchorage pier 125 ft high located at the south end of the bridge. See Fig. 4. (Figs. 1, 2 and 3 appeared in Part I.)

All three of the deep-water caissons are identical in design, being 53 ft wide by 102 ft 6 in. long. This is about the size of a modest town lot, large enough for a six-room house, a two-car garage, a patio, barbecue, flower garden, and small lawn. The caissons are of reinforced concrete construction with outer walls 3 ft thick and inner walls 2 ft 6



in. thick. When completed the piers will be 149 ft high, about the height of a 14-story building. Each caisson is divided into 18 dredging wells approximately 14 ft square. The four corners of the caisson are rounded on a 12-ft radius to reduce pressures from high-velocity currents during sinking operations.

Cutting edge welded in drydock

The bottom 13 ft of the concrete walls of each caisson are protected by structural-steel cutting edges fabricated from steel plates by welding. The plates are 3/8, 1/2, and 3/4 in. thick. These steel cutting edges, which weigh about 400,000 lb per caisson, were fabricated at the Bethlehem Pacific Coast Steel Shipbuilding Yards in San Francisco, 32 miles from the bridge site. The sections were assembled on a shipbuilding drydock and welded together. Then the cutting edges were filled with concrete and the outside walls of the caisson were extended to a total height of 31 ft by placing 4-in. precast slabs around the periphery. See Fig. 5.

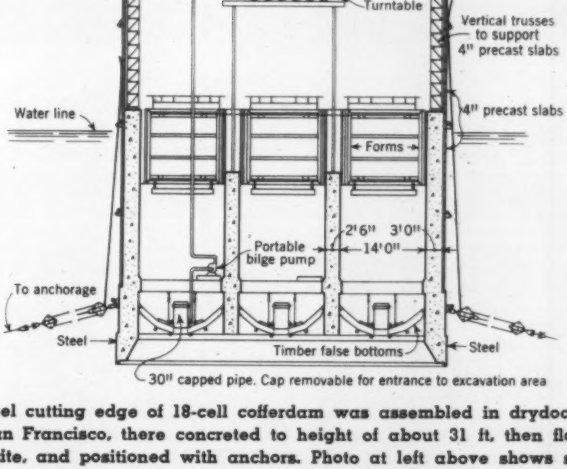

2-concrete hoppers
Traveling belt
Turntable
Vertical trusses to support 4" precast slabs
4" precast slabs
Water line
Forms
2'6"
3'0"
14'0"
Portable bilge pump
To anchorage
Steel
Timber false bottoms
Steel
30" capped pipe. Cap removable for entrance to excavation area

FIG. 5. Steel cutting edge of 18-cell cofferdam was assembled in drydock of shipyard in San Francisco, there concreted to height of about 31 ft, then floated and towed to site, and positioned with anchors. Photo at left above shows steel base of caisson in drydock, with cutting edge in place. Photo at right above, and drawing, show caisson as it was towed to site. Note lightweight vertical trusses supporting 4-in. precast concrete slabs used for external forms. Concrete hoppers and belt conveyors were added after caisson was in position.

The use of these 4-in. precast slabs is an innovation developed by the contractor for reinforced-concrete caisson construction. The slabs, precast at the Basalt Rock Company's plant, become an integral part of the 3-ft-thick outside wall when the caisson is completed. Some were transported 39 miles by barge to the drydock and some about 9 miles by truck to the bridge site. The slabs were cast in sections 10 ft high by 16 ft long, and reinforced at mid-section with 3/8 in. vertical bars on 11-in. centers and 3/8-in. horizontal bars on 6-in. centers. The outside surface was cast smooth, but the inside surface was roughened and keyed for bonding to the poured-in-place section of the outside wall.

To support the slabs, small vertical steel trusses 25½ in. deep were fabricated and cantilevered up from the concrete and steel cutting edge below. The slabs were then secured to these trusses, and the horizontal reinforcing bars in the slabs were welded together at the joints between slabs. After erection there remained in the vertical joints an opening of 1/8 to ¼ in. At the horizontal joints the slab edges were seated on each other and there was no clear opening. To seal these joints and make them watertight, the contractor used a commercial application of fiber-glass fabric and fiber-glass sealing compounds.

There are several advantages in this type of construction. For one thing, it greatly reduces the weight of the caisson by making the top 20-ft section of the outside wall 4 in. thick as compared to 36 in., thereby improving its buoyancy. Then, too, the precasts slabs save the time and expense of placing and removing form work. This tends to speed up construction at the bridge site during caisson sinking. A safety factor is also provided since slabs can be placed quickly and joints sealed to provide additional freeboard and buoyancy should the need arise.

Bottoms of dredging wells are closed with "false bottoms" fabricated from heavy timbers. Through each of these false bottoms is placed a short section of 30-in. steel pipe, inside of which there is a supplementary false bottom in the form of a concrete plug that can be removed and replaced when desired.

After the caisson had been made seaworthy, the drydock was lowered into the water and the caisson was floated out and towed to the bridge site. The first caisson, for Pier 2, was maneuvered into position on July 16, 1956. See Fig. 4.

The purpose of the 30-in. steel pipe running through the false bottom of the caisson is twofold. It makes possible access to the excavation area under the caisson for inspection. This will be desirable in case of excavation difficulties during sinking and for final inspection when the caisson comes to rest on bedrock at the bottom. The other purpose is to provide access for lowering high-pressure jets and pumps into the excavation area below the caisson.

Sinking by jetting and pumping

Here again the contractor has developed a new method of sinking the caissons through the mud, sand, and gravel overlying bedrock. Instead of the conventional method of excavating the material from beneath the caisson by clamshell buckets lowered through the dredging wells, the contractor proposes to loosen the material by jet and to pump it out into barges for disposal.

Four Chicksan Intelli-Giant jets are lowered through the four center dredging wells. These jets can be operated at pressures of from 30 to 300 psi. They are so rigged that they can be lowered or raised vertically, turned in any direction horizontally, or positioned at various vertical angles. These jets are sufficiently powerful to cut loose the overburden so that it can be pumped to the surface.

Before starting the caisson work, the contractor had dredged the site for each pier to a depth of about 100 ft below the water surface, which left about 32 ft of mud, sand, and gravel through which to sink the caisson. The contractor anticipates that the bottom 10 ft of material may be too coarse to jet and pump, in which case it will be necessary to remove some of the false bottoms and dredge by clamshell in combination with jetting and pumping.

For concreting the caissons, the contractor has constructed on the south shore a concrete plant with a capacity of 120 cu yd per hour. Concrete is discharged into 6-cu yd buckets and barged to the piers in three specially constructed barges capable of carrying eight buckets each. About 20 min are required from the time the barge leaves the mixing plant until cranes pick up the buckets for unloading into concrete hoppers at the pier.

For placing concrete in pier walls and partitions, two concrete hoppers are set up, one at the center of each half pier. Each hopper discharges onto a belt conveyor which can be turned and extended to discharge at any point on the half pier. One 10-ft section of pier can be poured in one day. About four days are required to allow the concrete to set, to move forms, and to place reinforcing for the next 10-ft section, so that sinking operations proceed at the rate of about 10 ft per week.

The fender system to protect the piers from ships is of reinforced concrete slabs and girders supported by 150-ft steel pipe piles of 24-in. diameter filled with concrete. The piles are fabricated from 1½-in. steel plates and are put in place by jetting. When a pile reaches bedrock, a spud is used to break up the shale and sandstone, which are then pumped to the surface while the pile is being driven about 3 ft into the bedrock to form a key. Once a pile has been lifted into driver leads and the jets have been rigged up, only about 20 min are required to jet and drive into bedrock.

Superstructure design

The main part of the four-lane superstructure of the new Carquinez Bridge consists of double cantilever truss spans with a central tower. See Fig. 4. The two end anchor arms are each 500 ft long and the two central spans are each 1,100 ft long. Including the 150-ft central tower, the total length of the main structure is 3,350 ft. The two suspended spans are each 433 ft 2⅜ in. long.

Trusses are spaced 60 ft from center to center and support a 52-ft concrete roadway with two 1-ft 10½-in. steel curbs. The roadway slab for the two anchor arms is to be of standard-weight concrete while the slab for the remaining part of the structure is to be lightweight concrete weighing 100 lb per cu ft.

Three types of steel were used in the design of the superstructure. They are A7, A242 and T1, and the allowable unit tensile stresses are as follows:

A7: 18,000 psi for all thicknesses
A242: 27,000 psi for thicknesses of less than ¾ in.
A242: 24,000 psi for thicknesses of ¾ and 1½ in.
T1: 45,000 psi for all thicknesses

In the design of cantilever trusses of this length, supporting four lanes of traffic with a concrete floor slab, one of the big problems has always been the make-up of the heavily stressed members in the area of the supporting towers. These members frequently contain so many thick and heavy plates that their resistance to bending between joints produces high secondary stresses, sometimes greater than the primary stresses. In the past some of this difficulty with high secondary stresses has been overcome by the use of pin-connected eyebars and pin-connected compression members. The reliability of the pin-connected compression member to relieve secondary stresses is somewhat questionable, since the moment

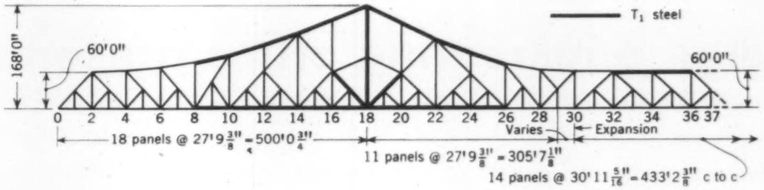

T₁ steel
168'0"
60'0"
60'0"
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
37
Varies
Expansion
18 panels @ 27'9 3/8" = 500'0 3/4"
11 panels @ 27'9 3/8" = 305'7 1/8"
14 panels @ 30'11 5/16" = 433'2 3/8" c to c

FIG. 6. On truss outline, members fabricated from high-strength T 1 steel are indicated. Other members are of A 242 steel except those carrying lightest loads, which are of A 7.

TABLE I. Comparative design of member L 16-L 18

	T 1	A 242
Max. dead-load truss deflection	130%	100%
Moment of inertia	17,700 in.^{4}	51,900 in.^{4}
Bending stress	2,900 psi	19,200 psi
Ratio of secondary stress to primary stress	10%	110%

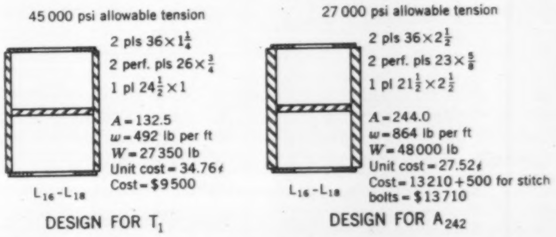


FIG. 7. Two designs for panel L 16-L 18 are compared, using two types of steel, T 1 and A 242. Size, plate thickness, weight of member, and cost are given.

required to reproduce rotation in the pin may be as large as the moment induced by the secondary stress.

In any event the use of a high-strength steel which would allow the make-up of members to retain reasonable flexibility appears to be the best answer to the problem of secondary stresses. Two designs for these critical members are compared in Table I. One design utilizes A242 steel and the other, T1 steel. From these comparative figures it can be seen that the high-strength steel has a considerable advantage from the design standpoint and also yields greater economy.

Saving with high-strength steel

Using the unit bid prices for A242 and T1 received from the low bidder, the total saving realized by the use of T1 for the critical members was estimated to be approximately $800,000. Fig. 6 indicates which members were fabricated from T1 steel, and Fig. 7 shows the economy of using this high-strength steel for member L 16-18, even at a higher unit cost.

Before deciding on the use of this steel, the Testing Laboratory of the California Division of Highways ran extensive tests on the parent metal and on butt-welded joints made from ½-in., 1-in., and 1½-in. sample T1 steel plates. The butt-welded samples were made by using a semi-automatic shielded arch, automatic submerged arc, and three types of manual low-hydrogen processes.

The average test results for the parent T1 steel indicated a yield strength of 111,000 psi, an ultimate strength of 120,000 psi, and an endurance limit of 55,000 psi. The steel exhibited excellent ductility.

The welded joints provided joint efficiencies from 87 to 100 percent of the ultimate strength of the parent metal and endurance ratios of 27 to 45 percent of the ultimate strengths of the corresponding welded joints. The welds exhibited moderate ductility and some porosity.

It was necessary to give considerable attention to butt-welded joints of T1 steel because rolling mills could not roll plates the full length of the members. Advantage was taken of this fact however by increasing the plate thickness near joints to compensate for the loss of net section due to holes for truss joint connections.

Advantages of welding

Experience gained by the California Division of Highways on the design and fabrication of thousands of tons of steel girders in the past few years prompted the consideration of steel truss members fabricated by welding in lieu of the customary stitch rivets.

This appeared to provide various advantages such as: (1) The number of member shapes could be reduced to three for H-sections, four for box sections, and five for box sections with interior webb. (2) All members could be made from plates only, eliminating the use of connecting angles. (3) There is a good opportunity to greatly simplify shop fabrication, with a corresponding reduction in cost, because all stitch riveting and fitting are replaced by four continuous fillet welds. (4) Maintenance, always a costly item near coastal waters, should be made easier by the smooth surfaces achieved by welding. Surfaces are free from rivet heads, lacing bars, and other small vulnerable details which are costly to clean and paint.

Design plans call for making field connections at truss joints by high-strength bolts, the contractor having an option between rivets and high-strength bolts for shop connections. Plans now being prepared by the fabricator, the American Bridge Division of the U. S. Steel Corporation, indicate that high-strength bolts have been chosen for shop connections. High-strength bolts for field connections were decided on for several reasons. First, it was the opinion of designers, based on numerous past tests, that the average high-strength field bolt is superior to the average field-driven rivet in performing the fastening job it is designed to do. Field inspection results for a good high-strength bolt are more positive than those for a satisfactory field-driven rivet. The development and training of an efficient bolting crew is much easier than the development of an efficient riveting crew. For these reasons the designers felt that high-strength bolts were likely to produce more reliable field joints at reduced costs. Field erection of the superstructure is scheduled to start in February 1957.

Does the large engineering office present

Viewpoint of an employee in a private organization

C. W. GRIFFIN, JR., J.M. ASCE

Structural Engineer, Philadelphia, Pa.

The answer to the topic question is of course, "Yes, the large engineering office does present special challenges to both employer and employee." There are many employer-employee problems common to organizations of all sizes, but there is a class of problems inherent in large organizations which is almost non-existent in the more intimate atmosphere of small offices.

The problems associated with bigness have grown with the expansion of engineering departments during the past several decades. As industry expands and increases in technological complexity, the demand for engineers grows at an accelerating rate. And in dealing with engineers in great numbers, the personnel departments of large corporations often have lost sight of them as individuals and treated them, to use a phrase I have stolen, as "depersonalized units of mass administration." Perhaps the more extreme examples of these mass-oriented personnel techniques occur in giant firms employing electrical and mechanical engineers. But these same practices exist in lesser degree in organizations that employ civil engineers.

In the recent EJC Report, "Professional Standards and Employment Conditions," some principal causes of employee dissatisfaction are discussed. Generally speaking, these complaints concern both the lack of professional status accorded the employee and inadequate pay. Complaints in the first class include the feeling of not being identified with management and the use of engineers for subprofessional, narrowly specialized tasks with little regard for their training and interest. Many young engineers have been driven from the engineering design field by the tedium and lack of creative challenge in their first jobs, a phase often prolonged well beyond the necessary breaking-in period. Another common complaint of young engineers is that they are seldom given an opportunity to see the results of their designs and drawings brought to life in the field, an experience which inevitably stimulates them to greater interest and effort.

Salary "compression"

Economic complaints mainly concern "salary compression," that is, inadequate salary differentials for varying levels of engineering experience. One of the points listed in the EJC Report states that there is "too small a differential between the pay of engineers and members of the skilled trades." Actually the complaint of some engineers is that this pay differential is too great —the skilled tradesman being on the high side. Certainly there are many well-qualified, experienced engineers earning less than the $4.05 hourly wage of bricklayers in the New York area.

The very fine report of the Los Angeles Section's Junior Forum Committee on Salaries in 1954 included curves showing the accumulated lifetime income of a journeyman plasterer (deducting 30 working days' pay for annual loss), a civil engineer, and a medical doctor. Based on 1954 wage levels, the curves showed that 40 years after graduation from high school the civil engineer had finally caught up with the plasterer, but in spite of a good head start on the medical doctor, his lifetime earnings were only one-half those of the doctor. These curves appeared in the report of this study in CIVIL ENGINEERING for November 1954, pages 53-55.

The EJC Report previously referred to recognizes the widespread failures of management to provide a satisfactory professional environment for employed engineers. It makes recommendations concerning management's responsibility for surveying areas of "communication, recognition, and salaries, and where found wanting, to correct them to conform with standards of professional practice." Unfortunately however, those who most need to reform are least likely to do so. Certain prevailing practices make it clear that some elements of management have no desire to raise the professional and economic status of engineers but rather hope to keep them at the level of tradesmen.

Job shops and middlemen

One of these employer practices, the so-called "job-shop," is becoming more and more common with the increasing shortage of engineers. A recent advertisement in the *Wall Street Journal*, under the heading of "Business Service," reads as follows:

"Engineers Available—What do you need? A second engineering department to help overcome peak loads? Engineers, designers, checkers, draftsmen? Our men will work in your offices or ours. 'Borrow' one man or 100 men for one month or one year or more. Most rates around $5.00 per hour. Hourly rate covers everything—no premium for overtime, no limit by us on number of hours worked per week. . . . We send men anywhere in the U.S.A. These types of designers and engineers available: machine designers, stress analysts, structural designers, etc."

Obviously the sole interest of the "job-shop" operator in his engineer employees is the profit he can make out of them. The services of engineers are advertised under the heading of "Business Service" in precisely the same manner that machinery is advertised. It is amusing to contemplate the reaction of the American Medical Association to an advertisement reading: "Doctors Available—What do you need? Surgeons? Heart Specialists? Neurologists?"

This advertisement, which is not the only one of its kind, is highly significant. The fact that a major American business journal sees nothing wrong in publishing such an ad, that some elements of management do avail themselves of engineering services by this means, and that even a mi-

special challenges to employer and employee?

Two articles based on papers in a symposium presented at ASCE's Pittsburgh Convention, before the Conditions of Practice session presided over by Glenn W. Holcomb, Chairman of the Department of Conditions of Practice.

nority of engineers receive higher wages working for a middleman profiteering from their work, indicates a sad lack of professional recognition for engineers. The situation demands attention by the engineering societies, and unless they can meet it with more vigorous action than a few gentle remonstrances aimed at no one in particular, the engineering profession will continue in its present trend toward the status of a trade.

Driven to collective bargaining

Another unlovely practice brings up the always interesting topic of collective bargaining. Anyone who has taken the trouble to read the returns from the 1953 ASCE Questionnaire on Employment Conditions knows that civil engineers are overwhelmingly opposed to labor union membership. Less than 1 percent of the respondents expressed a desire for labor union representation. Denouncing labor unions to civil engineers is like denouncing Socialism to the National Association of Manufacturers. The only concern of engineers with labor unions is to avoid being forced into them against their will. However, 36 percent of the survey respondents were not opposed to engineers forming their own professional employee collective bargaining units.

One of the strongest arguments against collective bargaining is that engineers should be rugged individualists and make their own economic way. However, the rugged individualist can operate only in a free enterprise system, the preservation of which demands the common observance of certain rules of fair play. When employers attempt to restrict the free market by entering into collusive intercompany agreements not to "pirate" one another's engineers, they are dooming individual efforts for economic advancement and inviting collective bargaining to enter their doors. Engineers are a conservative lot. When they resort to such rather radical measures as unionization in an effort to solve their employment problems, it is evidence of grossly unsatisfactory conditions. Collective bargaining is the symptom, not the disease.

What then are the prospects for the cure of these economic and professional ills suffered by employees in large engineering offices? Certainly the present high demand and short supply of engineers will do much toward solving the economic problems, assuming no major economic recession. The rising starting salaries of today's civil engineers, which average $5,100 per year, or 50 percent higher than this average in 1951—creates an irresistible pressure for increasing the salaries of more experienced engineers.

The young graduate of 1956, his esteem built up through the wooing of perhaps a dozen companies, will hardly be content with the meager average annual raises received by the engineers of past decades. There is even a faint hope that the outmoded personnel policies of many companies will be reformed. Some companies in the Philadelphia area have learned that rewarding individual merit and initiative is economical in the long run. Not only does good work deserve high pay, but high pay stimulates good work.

To live the professional life to its fullest, an engineer must see the results of his work. He must act an individualist's role if he is to sense directly his impact on society. When engineers are hired en masse, placed in small corners with narrow jobs, subjected to the impotent feeling that goes with the inevitable bureaucracy of large organizations, the problems of professional status become very difficult. When to these factors are added such conditions as "job-shop" employment, these professional problems become nearly insolvable.

Employees have obligations too

Many engineer employees, of course have themselves to blame for their troubles. Engineers who are drawing substandard pay today are not taking advantage of their opportunities. If more low-paid engineers would desert their employers they would help to force the pay scale of the entire profession upwards. If they choose to accept low pay because of inertia or the appeal of "security" then they have no just complaint. Similarly, many engineers who complain of lack of professional recognition have done little to earn that recognition.

The role of our Society in bettering employment conditions should not be overlooked. ASCE, through a policy statement prepared by the Committee on Employment Conditions, has taken the lead in sponsoring the "professional employee" provisions now incorporated in the Labor Management Relations Act, the aim of which is to prevent engineers from being forced into trade unions against their will. The Committee on Salaries has furnished valuable data as criteria for engineers' wage scales. However, there is a strong sentiment favoring adoption of a more aggressive program in advancing the welfare of employed civil engineers. The Task Committee on Scope of Professional Activity, created earlier this year by the Board of Direction, is now studying the organizational changes involved, especially the legal and financial aspects.

The potentialities of such changes are great, but a mere change in organization is not enough. If ASCE is to aid the employed engineer in his quest for professional status, it must vigorously oppose not only labor unions but also those elements of the business world whose economic interest is advanced by degrading engineering to the level of a trade.

(*"Viewpoint of an Employer" on following page*)

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(Continued from previous page)

Viewpoint of an employer in a private organization

J. D. CARPENTER, M. ASCE

Vice President, Gannett Fleming Corddry and Carpenter, Inc., Engineers, Harrisburg, Pa.

To better understand the situation in a large engineering office it is necessary to know why and how most of these organizations were formed and grew, and the necessity for them in our contemporary society. By a large engineering office I mean a consulting firm such as the one I am connected with, as my knowledge does not extend to other types of organizations.

Many engineering organizations started and grew in about the same way as ours did. Ours was started 42 years ago by one man, Farley Gannett, who joined ASCE in 1906. Soon he had several jobs and needed help so he invited an engineer friend to join him, and a small partnership was formed which in a few years consisted of three partners and a staff of 6 or 8. In order to have a more flexible organization, and on the advice of their attorneys, this partnership was soon changed into a corporation in which the partners became stockholders. As the country grew, so did the organization. More engineers joined it. At first they were employees. Later, after they had gained experience and had proved their ability, they became stockholders and employers—but at the same time they were also employees.

In our office the owners, partners or stockholders are nearly all engineers and all are working within and for the organization. We now have 22 firm members or stockholders, about 80 registered professional engineers, and 300 assistants, such as members of survey parties, inspectors, draftsmen, and clerical help. The younger engineers are continually moving up to become stockholders. About one in four acquire an ownership position and the added responsibility that goes with it.

Engineering organizations have grown large because of the increase in size, complexity, and number of our public and private works, and because of the great hurry there is today to get design and construction completed once a project has been decided on.

The special challenges to the employer come both from within and from without the organization. From without, the large office must be able to meet the challenge and competition of industry, the federal government and the state, and other employers of engineers, by offering equal or better opportunity, wages, and working conditions. The quality of the work must also compare favorably with the best.

Challenges from within

From within, the challenge to the large organization requires it to build up a closely knit and able group of engineers who are capable of handling large and important work. These men must be well satisfied with their work and working conditions. Also, they must do their work well and check it carefully before it leaves the office.

The employers, being in most cases employees also, have established the following working conditions in many of the large engineering offices:

1. Employees get good and **varied experience.**
2. Their **pay scale** is equal to or slightly above the current scale for the work they are doing.
3. **Chances for advancement** and for salary increases are exceptionally good.
4. **A pension plan** is in effect, with most of the cost paid by the firm.
5. **Group life insurance** is provided with most or all of the cost paid by the firm. In our firm this insurance starts at $2,000 and goes to $15,000, the employee's family or estate being the usual beneficiary. We pay the entire cost and carry about one million dollars of group life insurance, all of which is payable to the beneficiaries of our employees. This is particularly beneficial to some of the men who cannot get insurance as individuals.
6. **Extra salaries** are often paid for extra endeavor.
7. A **bonus,** which is usually a percentage of the profits, is declared and paid each year.

Competition from without

One of the special challenges that large employers of engineers must meet is the competition of industry, government, and consulting firms in obtaining the services of young engineers. To be successful in this they must keep in contact with the engineering schools, interview the better students, and have something special to offer them. At this stage, starting salary and fringe benefits are very important, but they are still not as important as the reputation of the firm, opportunities for varied experience, assured recognition of individual effort, good working conditions, pleasant surroundings, and the possibility of advancement to partnership or owner status.

Once the young men have joined the organization, the problem is how to keep them satisfied. This presents an equal challenge, for employees cannot be kept insulated from the approach of other companies, from reports of greener pastures elsewhere, or from offers of other positions which may pay more than we are able to do. Our answer to this challenge is the recognition we give the men after they are employed. We believe it is the duty of the principals of our firm to know our men personally and to keep informed on what they are doing. To fall all over ourselves in being cordial when we take on new men and then fail to recognize them thereafter is one of the very best ways to lose them.

We attempt to learn what each man's particular talents seem to be, arrange to have these talents recognized, and prevent him from falling into a narrow rut. We encourage registration and participation in refresher courses, even to the extent of sharing in their costs. When the men become registered we recognize this milestone, at least to the extent of having their certificates framed and hung in a prominent place. We like the plan of hanging every certificate on the wall in the reception room and believe that such practices are good.

All these things present special challenges to the larger employers of engineers but we believe that these challenges can be met by special efforts to maintain close contact with the individual employees, to show appreciation of their efforts, and to treat them as professional men rather than just as hired help.

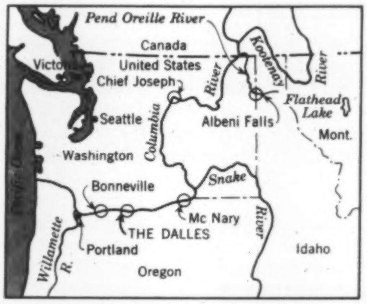

Pend Oreille River
Canada
United States
Victoria
Chief Joseph
Seattle
Washington
Columbia River
Kootenay River
Flathead Lake
Albeni Falls
Mont.
Snake
Bonneville
Mc Nary
THE DALLES
Portland
Oregon
Idaho
Willamette R.
River
Pacific Ocean

FIG. 1. The Dalles Project, under construction by Corps of Engineers, U. S. Army, will have initial generating capacity of 1,092,000 kw. Two units are scheduled to go on line in November 1957.

The Dalles diversion made with rock-fill dam

Model studies develop successful method

MARVIN J. WEBSTER, A.M. ASCE

Chief, Hydraulic Section, Portland District, Corps of Engineers, Portland, Ore.

Construction of The Dalles Dam on the Columbia River was started in February 1952 and is scheduled for completion, with power on the line, in the fall of 1957. The dam is located near The Dalles in Oregon, approximately 192 miles above the mouth of the Columbia River (Fig. 1).

The Problem

The Columbia River in its natural course flowed from Big Eddy through a narrow channel by Louise Island. This main channel was closed by the construction of a rock-fill dam, a part of the sixth and final major contract, during the period from September 10 to October 17, 1956. The location of the rock-fill dam relative to the other structures is shown in Fig. 2. River flow will be diverted through eight skeleton units of the powerhouse until the pool is raised in March 1957.

The channel closed by the initial or diversion fill was approximately 500 ft wide. This diversion fill, raised to approximately El. 83, was roughly 250 ft in width at the top (except at the right bank) and contained about 270,000 cu yd of material. The top of the completed rock-fill dam will be at El. 185 and will require a grand total of approximately 3,500,000 cu yd of material. The normal pool is at El. 160 (see Fig. 3). The lowest part of the natural channel to be covered by the rock fill was at El. −100.

During the latter part of 1952, an estimated 1,000,000 cu yd of material from excavation for the powerhouse in the first major contract was disposed of by dumping in the channel to a height of approximately El. +20 (Fig. 3). This disposal fill forms the base for the rock-fill dam. The material varied in size from fines up to 1,000-lb rock.

A check survey in August 1956 revealed that there had been very little movement of material in this disposal fill during the high-water flows of 612,000 cfs in 1953, of 550,000 cfs in 1954, of 543,000 cfs in 1955, and of 823,000 cfs in 1956.

Because of the magnitude of the closure operation, the amount of material involved, the limited time available to make the diversion, and the limited knowledge on rock-fill closures, a model study was conducted at the Bonneville Hydraulic Laboratory of the Corps of Engineers, U. S. Army, in Bonneville, Oreg. The general layout of the 1:40 scale model is shown in Fig. 4.

The model simulated approximately four-fifths of a mile of natural river channel including most of Big Eddy, powerhouse skeleton units Nos. 15

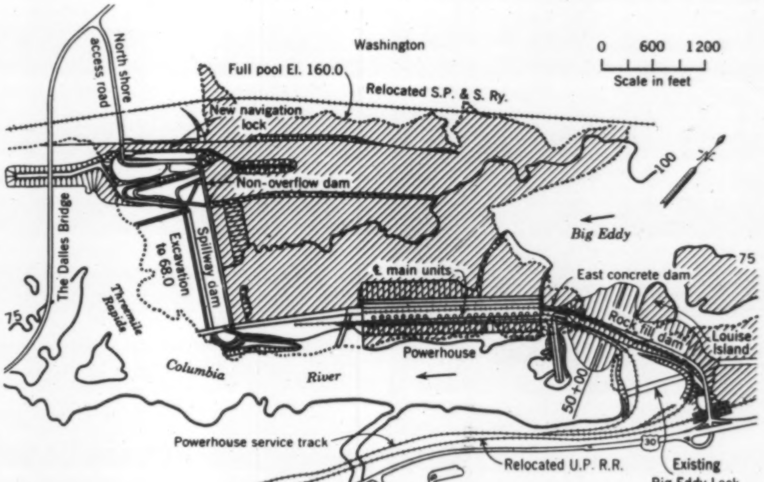

Washington
North shore access road
Full pool El. 160.0
Relocated S.P. & S. Ry.
0 600 1200
Scale in feet
New navigation lock
Non-overflow dam
100
Big Eddy
The Dalles Bridge
Excavation to 68.0
Spillway dam
Threemile Rapids
℄ main units
East concrete dam
75
Rock fill dam
Louise Island
Powerhouse
Columbia
River
50+00
Powerhouse service track
30
Relocated U.P. R.R.
Existing Big Eddy Lock
75
Oregon

FIG. 2. Closure at The Dalles Project was effected in fall of 1956 by dumping rock fill into channel 500 ft wide between Louise Island and powerhouse to form base for rock-fill dam. Successful closure method was based on extensive model studies.

through 22, the non-overflow dam between the powerhouse and the proposed rock-fill dam, and the cofferdam for the East Fishway. Prototype topography was simulated in concrete that had been set accurately to grade. As seen in the photograph that accompanies Fig. 4, the extreme roughness of the natural channel was simulated by small pieces of rock cemented to the concrete model surface to produce the correct roughness to scale. The simulated powerhouse units were constructed of wood and plastic.

Continuous stream-flow records since 1878 show that the daily mean flow in the Columbia River at The Dalles for the period October through February is approximately 100,000 cfs. Flow from October 15 through December 15, the period scheduled initially for construction of the closure to El. 90, has exceeded 200,000 cfs only twice, and then for short periods, in November 1907 and in November-December 1928. Consequently a maximum river discharge of 200,000 cfs was selected for placing materials in the rock fill during closure and it was decided that construction of the fill would cease during flows above this discharge. The 200,000-cfs discharge was simulated for most of the model studies.

It was felt that if the closure could be made at a river discharge of 200,000 cfs, lower discharges would not present difficulties. However model studies with lower discharges were scheduled for the selected closure plan. Because there was a possibility that a discharge of 300,000 cfs might occur during the closure period, this discharge was selected for stability tests on each plan of the closure fill studied in the model.

The model

It was recognized that true dynamic similarity, assuring rigorous reproduction of all hydraulic phenomena could not be attained in this model study. Since the effect of surface tension and elasticity is negligible for model studies of this type, Weber's and Cauchy's numbers could be neglected. The effects of gravity and viscosity were left to be considered. Although both the Froude (gravity) and Reynolds (viscosity) criteria cannot be satisfied when the same fluid (water) occurs in both model and prototype, in practice it is desirable to use water as the model fluid. Satisfactory model tests can be made with water when either the viscous or the gravitational forces predominate and all other forces are secondary. The proper law for similitude would be that for the predominate force, which in this case is the gravitational force, or Froude's model law.

The Dalles rock-fill model was con-

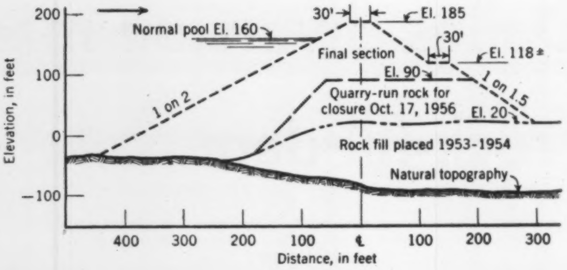

200
100
0
−100
Elevation, in feet
Normal pool El. 160
30'
El. 185
30'
El. 118±
Final section
El. 90
1 on 2
1 on 1.5
Quarry-run rock for closure Oct. 17, 1956
El. 20
Rock fill placed 1953-1954
Natural topography
400
300
200
100
℄
100
200
300
Distance, in feet

FIG. 3. Typical section through rock-fill dam at closure location shows sequence of placing operations.

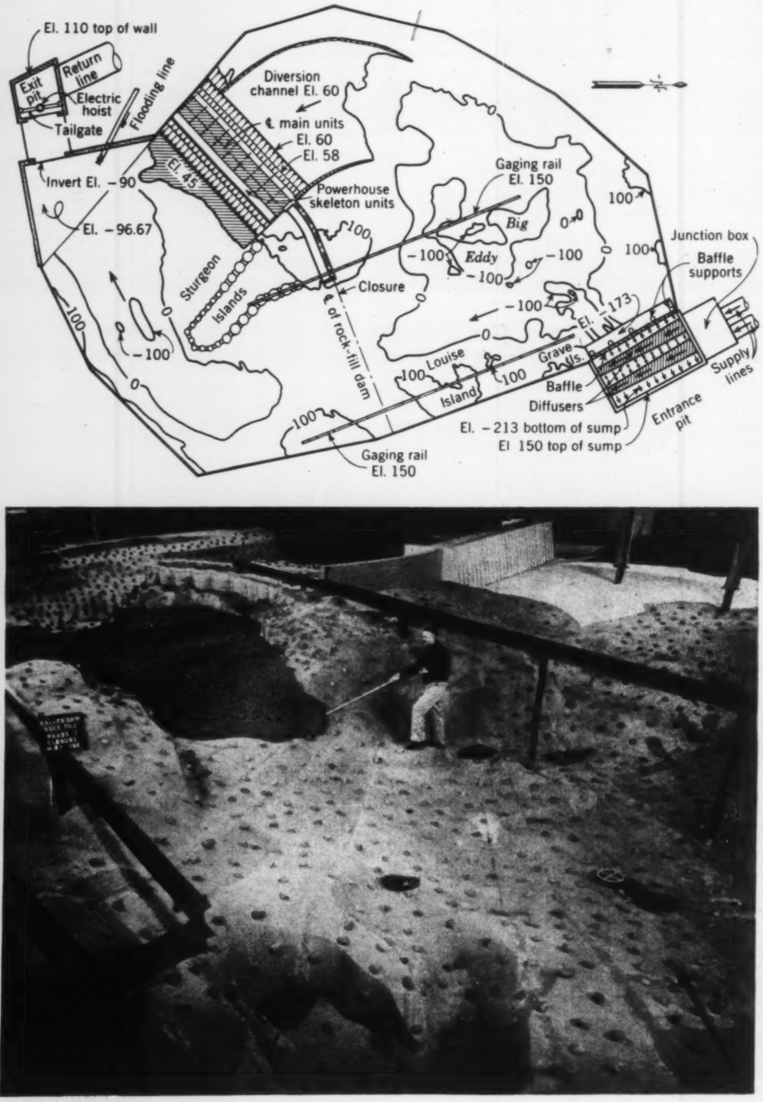

El. 110 top of wall
Exit pit
Return line
Electric hoist
Tailgate
Flooding line
Diversion channel El. 60
℄ main units
El. 60
El. 58
El. 45
Invert El. −90
El. −96.67
Powerhouse skeleton units
Gaging rail El. 150
100
Big
Eddy
−100
0
Sturgeon Islands
Closure
℄ of rock-fill dam
Junction box
Baffle supports
El. 173
Supply lines
Entrance pit
Grave Is.
Louise Island
Baffle
Diffusers
El. −213 bottom of sump
El 150 top of sump
Gaging rail El. 150

FIG. 4. Model of The Dalles Project to 1:40 scale at Bonneville Hydraulic Laboratory, Bonneville, Oreg., could simulate flows up to 400,000 cfs. Prototype topography was simulated in concrete molded to fit sheet-metal templates (see photo). Small pieces of rock cemented to concrete produce correct roughness to scale. Powerhouse units are of wood and plastic. Engineer points to disposal fill as it was placed to El. +20 in prototype in 1952.

TABLE I. Model-prototype relationships in simulating rock sizes

Characteristic	Dimension	Model-Prototype Ratio
Length	L	1:40
Area	L^2	1:1,600
Volume	L^3	1:64,000
Mass	L^3	1:64.000
Weight	L^3	1:64,000
Force	L^3	1:64,000

structed to an undistorted linear scale ratio of 1 to 40 to obtain geometric similitude. Selection of this scale was based on such things as space available, prototype area to be reproduced, water supply, and cost. In addition, the model was constructed to a scale such that fully developed turbulent flow would occur in the model, and the effect of viscous forces would therefore be minimized.

The relationships shown in Table I, based on Froude's model law, were used in similating rock sizes for use in the model. The various sizes of rock used in the model were crushed from besalt of the same density as that of the prototype rock. By using model rock of the same density as the prototype rock, and by selecting shapes similar to those expected in the prototype rock, the size of the rock was made to conform to the 1 to 40 linear scale used for the model, as shown by the following example:

Five-ton rock. Assume rock to be in shape of a cube with dimension on any side $=b$. Then

$$b = \left(\frac{W}{w}\right)^{1/3}$$

where W = weight, w = unit weight.

Using a rock density of 178 lb per ft^3,

$$b \text{ (prototype)} = \left(\frac{10{,}000}{178}\right)^{1/3}$$

$$= 3.830 \text{ ft}$$

$$\text{5-ton rock (model)} = \frac{10{,}000}{64{,}000}$$

$$= 0.15625 \text{ lb}$$

$$b \text{ (model)} = \left(\frac{0.15625}{178}\right)^{1/3}$$

$$= 0.09575 \text{ ft by weight}$$

$$b \text{ (model)} = \frac{3.830}{40}$$

$$= 0.09575 \text{ ft by size}$$

If a material of less density than the prototype rock were to be used, similitude of mass would be lost if geometric similitude in size were maintained, as shown by the following example.

Assume a model material with a density of 120 lb per ft^3.

DALLES DAM
ROCK FILL
TO STA 270
Q 200 000
M 57-131

With model river flowing at simulated 200,000 cfs, model fill is 84 percent completed. At this stage, 80 percent of flow is passing through uncompleted powerhouse units. Confetti traces show practically no movement along downstream half of fill.

$$\text{Mass (prototype)} = \frac{w}{g} = \frac{178}{32.2}$$

$$= 5.52795$$

$$\text{Mass (model)} = \frac{w}{g} = \frac{\frac{120}{64{,}000}}{32.2}$$

$$= 0.00005823$$

$$\frac{\text{Mass (prototype)}}{\text{Mass (model)}} = \frac{5.52795}{0.00005823} = 94933$$

or a ratio of 1:94933 rather than 1:64,000. Similarly, a similitude in mass could be maintained only at the expense of similitude in size.

Based on the above examples, use of the prototype fluid and of rock having prototype density was considered consistent with interpretation of the model results by Froude's model-to-prototype relationships. However, the effect of lack of true similitude of the viscous forces must be considered in using the results of the model study. The lower Reynolds numbers in the model will result in higher drag coefficients, even though the model flow is within the turbulent range, and there will be a tendency for the rock in the model to be carried further downstream than would the rock in the prototype, thus providing a factor of safety for the prototype fill construction.

Theoretical considerations, based on work by S. Isbash, show that 1,000-lb quarry rock weighing 178 lb per ft ^{3} should withstand maximum mean velocities of 14 fps in a smooth channel. The equation is:

$$V = 0.86\sqrt{2g\left(\frac{\Delta_1-\Delta}{\Delta}\right)}\sqrt{d} \text{ where}$$

C = empirical value of drag coefficient = 0.86

d = spherical diameter of rock, in ft

Δ_1 = unit weight of quarry rock = 178 lb per ft^3

Δ = unit weight of water

An equation developed at the Waterways Experiment Station shows that the quarry rock will withstand slightly higher velocities of 15.5 fps. This equation is:

$$V = 1.08\sqrt{2g\left(\frac{\Delta_1-\Delta}{\Delta}\right)}\sqrt{\;}$$

in which case,

d = side of a cube

The solution

In the initial plan it was proposed to construct the channel closure section of the rock-fill dam to El. 90 by a vertical-lift method. The fill material would be dumped from a cableway or from barges, and the crest of the fill would be kept as near to a uniform elevation as possible. Quarry rock, available in the immediate vicinity of the dam site, would be used to make the fill. Flow would be diverted through eight skeleton units of the powerhouse during the closure operation. Model studies showed that the rock fill could

be constructed successfully by this vertical-lift method using up to 1,000-lb quarry-run rock with a river discharge of 200,000 cfs. Also it was shown that the fill would be stable for a river discharge of 300,000 cfs.

The laboratory also scheduled tests using an end-dump method of closure. If successful, this method would eliminate the need for a cableway or barges, and the material could be trucked directly to the site of placement. By this method, using end-dump trucks, it would be possible to increase the material placed per day to 12,000 cu yd as compared with 3,500 cu yd by cableway, or 10,000 cu yd by barges.

The first study in the model in which the closure was made successfully by end-dumping, starting at the Oregon shore, was with a narrow fill having a top width of approximately 30 ft. It was proposed to expedite diversion through the powerhouse by constructing a narrow fill using a minimum amount of rock. The closure was made with quarry-run rock similating a maximum weight of 1,000 lb and a river discharge of 200,000 cfs. During the final stages of this closure, it was found that there was less movement of rock when the fill was angled slightly upstream into the stream, and closed more or less normal to the right bank. The rock was placed along the upstream leading edge of the fill, resulting in less rock being washed downstream and none being carried beyond the limits of the final fill.

At the completion of the tests using the end-dump method to build up a narrow fill, the schedule was revised to compensate for the faster rate of placing, and it was suggested that the full width of the large-rock section of the fill be placed to El. 90 initially. Following a similar alignment a fill which would be 250 ft wide in the prototype was constructed in the model. By placing the rock along the upstream side to provide a leading edge, a greater hydraulic loss was created in the channel and more flow was diverted through the powerhouse. Maximum bottom velocities were reduced from 21 to 17 fps with a river discharge of 200,000 cfs.

Model data with 96 percent of the

Actual closure proceeded as predicted by model. On October 8, 1956, fill was about 70 percent completed, to El. 90, as seen in top view. Middle view shows flow through gap just before closure on October 17. At 12:30 p.m. on that day, last rocks were dumped and bulldozed into gap (view at bottom), diverting entire flow of Columbia River through partially completed powerhouse.

closure completed are given in Fig. 5. These conditions are typical of those encountered during what is considered the critical range of closure. Surface currents when approximately 84 percent of the fill was completed, considered the start of the critical range, are shown in an accompanying photograph. It will be noted that the confetti traces show practically no movement along the downstream half of the fill. Rock was pushed into this section with very little movement downstream. It is believed that this condition contributed greatly to the successful construction of the closure fill. As the fill progressed across the channel, rock could be placed simultaneously at several locations along the 250-ft-wide face of the fill and at the upstream leading corner.

To check the stability of the fill, the flow in the model was increased during various stages of fill completion to similate a river discharge of 300,000 cfs. From approximately 70 percent to final closure, there was some movement of the rock at the upstream leading corner of the fill, but a stable condition was reached in a very short time.

Model studies have also been made simulating river discharges of 90,000, 100,000 and 150,000 cfs. In all cases the fill was constructed successfully using quarry-run rock. This rock sloughed with slopes of approximately 1 to 1.

Solution applied to prototype

Perhaps one of the primary factors contributing to the ease with which the fill was built up with quarry-run rock was the arrangement of diverting the river flow through the eight skeleton units of the powerhouse. The percentages of flow through the powerhouse at various stages of fill completion are given in Fig. 6.

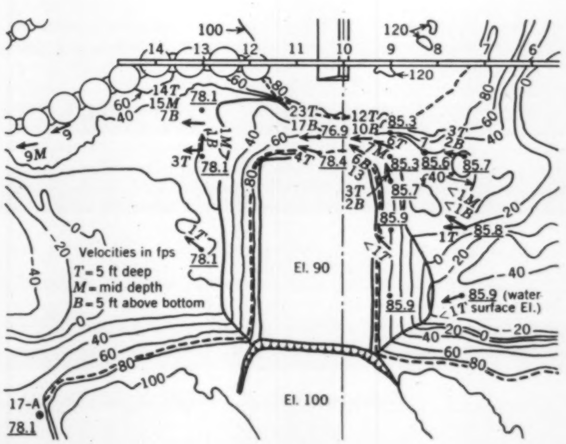


FIG. 5. Typical flow pattern in model is shown for condition when 96 percent of closure has been completed, at river discharge of 200,000 cfs. Maximum velocity simulating 17 fps was measured 5 ft above bottom. Bed velocity tending to move rock would be slightly lower.

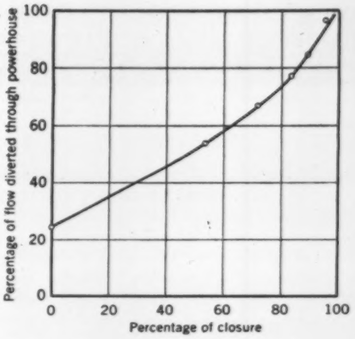


FIG. 6. Percentages of flow through eight skeleton powerhouse units are given for various stages of completion of diversion fill from El. 20 to El. 90, using end-dump method at flow of 200,000 cfs. About 25 percent of flow was passing through powerhouse before start of closure operation.

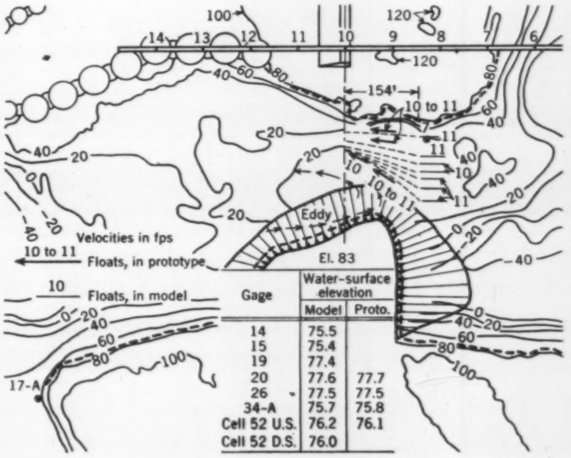
The closure contract includes completion of the rock-fill dam to El. 185. A blanket of graded gravel and sand was placed to seal the upstream face of the rock fill. The end-dump method permitted placement of the blanket material to follow placement of the quarry-run rock, and made it possible to finish the blanket in the part below El. 90 within a short time after diversion was completed.

The model study proved invaluable in solving a most difficult problem of diversion in the construction of The Dalles Dam. It indicated that a closure could be made using quarry-run rock with the range of river discharges expected, and in the time scheduled. Closure by the end-dump method resulted in a considerable saving in cost over the initially planned vertical-lift method. Construction of the rock fill by the end-dump method in the prototype followed a pattern almost identical with that used in the model. River flow during the period of closure varied from 102,800 to 115,900 cfs, and was 109,700 cfs on October 17, 1956, the day final closure was effected.

Prototype water-surface elevations were observed on six gages and recorded daily during the period of closure. Velocity observations were made just prior to starting the closure and three times during the closure. Measurements were made daily to determine the shape of the fill.

Similar conditions tested in the model showed very close correlation with the prototype. A comparison of velocities and water-surface elevations observed on October 5, 1956, with the fill about 55 percent completed, are shown in Fig. 7. It is interesting to note that velocities in both model and prototype varied from 10 to 11 fps and that the greatest variation in water-surface elevations was 0.1 ft. Typical flow conditions in the prototype are shown in the accompanying group of the photographs.

The Bonneville Hydraulic Laboratory operates under the direction of Col. Jackson Graham, District Engineer, Portland District, Corps of Engineers. The studies were performed under the general supervision of Ben L. Peterson, A.M. ASCE, Chief, Engineering Division, and L. E. Knerr, Chief, Design Branch. The writer is head of the Hydraulic Section, and Harry P. Theus is head of the Laboratory.



Gage	Water-surface elevation	
	Model	Proto.
14	75.5	
15	75.4	
19	77.4	
20	77.6	77.7
26	77.5	77.5
34-A	75.7	75.8
Cell 52 U.S.	76.2	76.1
Cell 52 D.S.	76.0	

FIG. 7. Model and prototype velocities and water-surface elevations are compared for conditions prevailing during closure on October 5, 1956. River discharge was 11,450 cfs, and four of eight powerhouse units were open. See group of closure photographs.

THE READERS WRITE

A Building Construction Division?

To the Editor: The ever increasing complexity of engineering and the profusion of new materials in building construction is making professional interest in engineering and the management aspects of building construction a problem of increasing importance. To promote such interest, I feel that a new group within our Society might make a useful contribution.

There has been great pressure recently from the building industry for expansion of education for the construction industry. Such training has in many cases been initiated in educational institutions.

In some of these cases it has been found too difficult to reconcile the educational needs of the construction industry with the ECPD requirements for an engineering degree, and therefore some of these courses have been put into schools of business or merchandising. Since the construction industry needs much greater emphasis on engineering approach and methods, I believe that a group within ASCE would go a long way toward channeling these educational needs in the proper direction and toward providing creative impetus for a more systematic and scientific approach to the engineering and management problems facing the industry. It has long been the feeling of many that advances in technology and management have been insufficiently applied to building construction and that the industry is lagging behind other American industries.

It is to be hoped that such a group would find sufficient response in order to advance this cause of the ASCE. I should appreciate hearing from those who would like to comment on these ideas or who would like to participate in such a group. If sufficient interest is manifested, we could propose the formation of a Building Construction Division to the Society.

Werner H. Gumpertz, A.M. ASCE
Asst. Prof. of Building Constr.,
Dept. of Civil & Sanitary Eng.,
Mass. Inst. of Technology

Cambridge, Mass.

Thorough preparation needed for design

To the Editors: To those students who believe they can bypass such work as detailing, drafting, and surveying to become designers immediately upon graduation, the comments which follow may be helpful. For some time I have been bothered by this misconception. While some young graduates may be able to start as mathematical computers, it is not possible for them to start as designers in the true sense.

In my judgment no man who hopes to make progress in civil engineering could make a greater mistake than to become a computer upon graduation. Temporarily there appears to be a demand for computers, particularly in industry, but such men will quickly find themselves in competition with computing machines. New computing devices are announced almost every month, and we can all be sure that the machines will win.

There is a real place for computing machines in our profession for they are rapidly changing our procedures. They enable the engineer to become the master and lord over his calculations rather than being burdened and enslaved by them, as is now so often the case. Relieved from the burdens of exhausting calculations, the practicing engineer will have more time for creative work and for investigating new and alternative designs.

There is much more to engineering than arithmetic and mere proficiency in calculation. A qualified designer should be well grounded in many facets of his professional field. He must know something about materials, construction methods, shop practices in fabrication, erection procedures, the way structures are put together, the esthetics and proportioning of structures, economy in the use of materials as affected by practical construction requirements, and many other basic considerations connected with the building of structures. He cannot know what good plans are unless he himself has done some work on their preparation. Many of the things he should know for purposes of design are those he can learn well only by doing them himself.

The young engineer must not look upon the attainment of skills and the mastery of details as mere drudgery, having nothing to do with professional progress. Is it enough for the physician to know the theories of surgery and of the setting of bones without having the skilled hands with which to do such things? Is it enough for the law school graduate to read cases and make up his own mind about their merits without being able himself to carry out the labor of preparing complete and adequate briefs capable of convincing others?

The opportunities before our young civil engineering graduates are greater than ever before, not only from the standpoints of compensation and appreciation, but also from that of service in major accomplishment, and of building a greater future for our nation. We can only hope that all our young men will prepare themselves as fully as possible for their professional service so that they can measure up to the responsibilities which will be placed upon them, and at the same time reap the harvest of material and social benefits which will surely come to them as qualified professional engineers.

Enoch R. Needles,
Past President ASCE
Howard, Needles,
Tammen & Bergendoff

New York, N. Y.

Note: *This statement was prompted by an inquiry from Prof. Odd Albert, A. M. ASCE, of Polytechnic Institute of Brooklyn, concerning the practical preparation of his students for entering the profession, and the views of some of his prospective graduates who "do not intend do be draftsmen; they would like to be designers."*

Truss-tied arch bridges listed

To the Editor: In my letter to the editor in the December issue, p. 69, the transposition of a sentence gave a wrong impression. All the bridges listed in the second paragraph are *truss-tied* arch bridges, not *girder-tied*.

The list of truss-tied arch bridges is repeated here, as follows:

Mur River, Graz, 1881; Ihme River, Hannover, 1889; Kufürstendam Street, Berlin-Hallensee, 1892; Elbe-Trave Canal, 1898; Segeroth Street, Essen, 3 spans, 1910; Kleinfeld Street, Mannheim, 2-span continuous, pedestrian, 1920; Spree River, Wiederdammer, Berlin, 1924; Danube River, Gyor, first with side spans, 1925; Traun River, Ebelsberg, 1928; Oder River, Glogau, two single-track railroad spans side by side, 1928; Elbe River, Tetschen-Bodenbach, with side spans, 1930; Drava River, Maribor, with side spans, 1933; Oder River, Schwetig, double-track railroad, 1938; Zala River, Zalahidveg, 1948.

Louis Balog
Consulting Engineer

Binghamton, N.Y.

SOCIETY NEWS

Society's Buffalo Convention to Feature St. Lawrence Seaway Tour

Buffalo, Queen City of the Great Lakes, will be host to the Society's summer Convention slated for the week June 3-7. The Buffalo Section Steering Committee, under the chairmanship of Nathan Schwartzman, is arranging the kind of technical and social program that has long made ASCE Conventions the memorable events they are. However, the high point of the Buffalo Convention will be a special guided tour of one of the great engineering undertakings of our day—the St. Lawrence Seaway and Power Project. The Convention dates were set to coincide with a period of major construction activity at the Massena, N. Y., site.

In addition, Col. Loren W. Olmstead, Buffalo District Engineer, and Lt. Col. D. B. Williams are planning the St. Lawrence trip with the interests of ASCE members especially in mind. The tour will include such projects as the Grass River and Dwight D. Eisenhower locks now under construction. When completed, these two locks will lift vessels some 85 ft through the ten-mile Long Sault Canal by-passing the adjacent power dams. Each lock will be 800 ft long, 80 ft wide, and have a 30-ft depth over the sills. Some of the other interesting construction sites on the tour agenda are the Long Sault Dam, the Barnhart Island Powerhouse, and the Iroquois Regulating Dam, which will act as a control structure for the water upstream of Iroquois, Ontario.

Buffalo a Convention Center

As a tourist and convention center, the Buffalo area is host to over three million people a year. Situated at the eastern end of Lake Erie in western New York State's Niagara Frontier, it is served by main lines of all major transportation facilities of the northeast. American, Capital, Mohawk, and Allegheny Airlines; the New York Central, Pennsylvania, Lehigh Valley, and other railroads; Greyhound and other bus lines have major terminal facilities in Buffalo and mainline connections from there to all parts of the United States. From all directions first-class highways, including the famous New York State Thruway, also lead to Buffalo.

ASCE members and their families will enjoy convenient, modern, and comfortable accommodations at the Convention headquarters hotel, the Statler. Located in the heart of downtown Buffalo and overlooking Lake Erie, the Statler is within two blocks of some of the state's finest department and specialty stores—always a point of interest to accompanying families! A variety of entertainment and recreation is also at hand. For the sports minded there are swimming, boating, fishing, baseball, horse racing, golf and tennis. In the cultural field there are art and science museums, zoological gardens, summer theaters, and the famous Kleinhan's Music Hall. Clubs and hotels offer the best in night life.

Niagara Falls Easily Accessible

One of the great attractions of the Buffalo area, of course, is Niagara Falls—about half an hour's driving time from the heart of the city on the recently opened Niagara Thruway. Below the Falls, on the Canadian side, is the new Sir Adam Beck No. 2 hydroelectric generating station. Another major electric generating facility on the Niagara River is the Huntley Steam Station, which has installed capacity in excess of 750,000 kw and 400,000 kw of additional capacity under construction. Also along the river may be seen a pioneer hydroelectric plant, the Adams Station, which started supplying electricity to Buffalo in 1895.

Metropolitan Buffalo has a population of over a million, and in industrial stature the city ranks among the top ten in the United States. Steel plants, foundries, electro-chemical and electro-metallurgical companies, automotive plants, research laboratories, aircraft plants,

Steering Committee for the Buffalo Convention includes (left to right) Frederick W. Crane, Nathan Schwartzman, Lt. Col. Donald B. Williams, Edward J. Nunan, Newell L. Nussbaumer, and Louis S. Bernstein. Colonel Williams is assisting Col. Loren W. Olmstead, Buffalo District Engineer, in working out details of the St. Lawrence Seaway and Power tour. Mr. Schwartzman is chairman.

flour mills, bus and railroad manufacturing, electrical machinery and electronic devices are a few of the more than 1,700 industries represented in the Buffalo area.

Recently opened to traffic is the Buffalo Skyway, an over-city highway from which much of the city and harbor area of Lake Erie can be viewed. ASCE members should take special note of the many excellent design features incorporated in the Skyway. Among other notable engineering structures they will want to see are the Carghill Superior Grain Elevator, the Bethlehem Steel Plant, the Rainbow Bridge at the Falls, and the New York State Thruway. Many of these points are included in the planned Convention tours, and all are within easy-driving distance of downtown Buffalo.

Huntley Steam Station—one of the objectives of Buffalo Convention tours—is a 785,000-kw generating station. Capacity is now being expanded to 1,200,000 kw. This station is one of the interesting generating plants on the Niagara Frontier.

Details in Subsequent Issues

Additional features and details of the Buffalo Convention will appear in later issues. In the meantime, start making your plans now to be in Buffalo the week of June 3-7.

Daniel W. Mead Prizes to Be Presented at Jackson

Award of the Daniel W. Mead Prizes for 1956 was announced by the Board of Direction at its Pittsburgh meeting (November 1956 issue, page 70), and presentation of the prizes will be made at the Society's forthcoming Jackson Convention.

The Junior Member Prize of $100 in cash and a certificate was awarded to Robert A. Schaack, J.M. ASCE, of Burbank, Calif., for his paper on "Responsibilities of the Architectural Firm and the Engineering Firm in a Cooperative Undertaking." The Student Prize, consisting of $50 in cash and a certificate, goes to James Moser Anderson, of Pekin, Ill., for a paper on "Ethics of the Senior in Making Commitments with Prospective Employers."

Mr. Schaack, a registered engineer in the State of California, is working as a design engineer in the architectural and engineering section of a construction firm, which specializes in concrete Tilt-up construction. He recently completed sixteen months as field engineer on construction of a 300,000-sq ft rocket motor plant, and earlier did structural design work on all types of commercial and industrial building in the Los Angeles area. He is active in the Los Angeles Section's Junior Member Forum. Mr. Schaack received his B.S. degree from the University of Southern California in 1950.

Mr. Anderson completed an education twice interrupted by military service when he graduated from Swarthmore College in 1956. Prior to attending Swarthmore, he supplemented broad wartime construction experience as an officer in the Corps of Engineers with two years as a project engineer for the Pennsylvania Department of Highways and three years of architectural studies at Carnegie Institute of Technology. He is now employed as a staff engineer by the Caterpillar Tractor Co. Earlier this year he was the author of another paper which won second prize in competition at a Regional Student Chapter Conference held at Princeton University.

Robert A. Schaack

James M. Anderson

New ASCE Manual Lists Hydraulics Translations

At a March 1954 meeting of the Hydraulics Division's Committee on Research the need for a list of translations of foreign literature on hydraulics was discussed. Now, three years later, the fruit of that discussion is available as a new ASCE Manual of Practice, No. 35. The 81-page manual, priced at $1.00 to members and $2.00 to non-members, may be ordered by use of the coupon in the advertising section of this issue.

Manual No. 35 was compiled to meet the need of hydraulics engineers for a reference to the numerous translations by federal agencies and universities, which are scattered all over the country. The existence of many of these translations has not been known to many engineers needing them. It is believed that the present consolidated list of translations will reduce future duplication of effort between agencies or institutions as well as aid engineers engaged in hydraulic research.

Mayor of Jackson Proclaims Civil Engineers Week

To honor the profession and the Society which is holding its Spring Convention in Jackson, Miss., with the Mid-South Section as host, the Hon. Allen C. Thompson, mayor of Jackson, proclaims the February 18-23 period "Civil Engineers Week in Jackson." Seated, left to right, are James E. Jagger, Forest, Miss., member of Publicity Committee; O. B. Curtis, Jackson, secretary-treasurer, Mississippi State Board of Registration for Professional Engineers; L. L. Patterson, Starkville, Miss., president of Mississippi State Board of Registration; Mayor Thompson; Mrs. Sydney W. Chandler, Jackson, chairman, Ladies Committee; and Charles S. Hill, Jackson, chairman, Publicity Committee. Standing, in same order, are Burt Lomax, Jr., Jackson, director, Mississippi Society of Professional Engineers; Robert L. Morrison, Hattiesburg, Miss., member of Reception Committee; Ben T. Collier, Jackson, member of Steering Committee; Charles B. Patterson, Vicksburg, member, Technical Program Committee; Ellis B. Pickett, Vicksburg, Miss., member, Technical Program Committee; Don P. Reynolds, New York City, Assistant to the Secretary of ASCE; Willard J. Turnbull, Vicksburg, chairman, Technical Program Committee; Earl C. Meserve, Little Rock, Ark., auditor of Finance Committee and secretary-treasurer, Mid-South Section; and Norman R. Moore, Vicksburg, chairman, Steering Committee and ASCE Vice-President for Zone III.

Nuclear Congress to Display Operating Atomic Reactor

Visitors to the International Atomic Exposition and 1957 Nuclear Congress—set for Philadelphia, March 11-15 (January issue, page 82)—will be able to inspect a critical nuclear reactor in actual operation in Philadelphia's Convention Hall. Now in production at Aerojet-General Nucleonics, the reactor has been approved by the Atomic Energy Commission as completely safe for public exhibition without special shielding.

Developing a normal output of 100 mw with a peak of 3 w, the reactor is designed for use in hospitals, educational institutions and industry for production of radioactive isotopes. It includes a remote-control console. All shielding required has been built into the reactor so that it is completely self-contained.

The reactor is about 9½ ft high and weighs 22,000 lb. The enriched U-235 uranium is in the form of a powder dispersed in solid polyethylene plastic.

This will be the first time that an actual "critical" reactor has been on public exhibit except for the U.S. reactor in Geneva, Switzerland. At the previous International Atomic Exposition in Cleveland a pickel-barrel type of reactor was on display, but that unit was non-critical and thus unable to maintain fission without the presence of a separate neutron-producing source.

In addition to the International Atomic Exposition, the Nuclear Congress will include a concentrated program of more than 200 technical papers and a two-day conference for business executives interested in atomic energy. Among more than forty major topics due for consideration are nuclear generating stations, reactors for ship propulsion, disposal of radioactive wastes, production of atomic fuels, legislative and legal problems, atomic energy development abroad, and practical commercial applications of the atom.

Engineers Joint Council is coordinating the Congress, which is described as "possibly the most significant event of its kind ever held in the country." Copies of the advance program may be obtained from EJC, 29 West 39th Street, New York 18, N. Y.

Group Disability Plan Offers Increased Benefits

Further broadening of the Society's Group Disability Plan to make conditions more favorable to the insured is announced by the underwriters, the Continental Casualty Company of Chicago. Changes in four sections of the contract, effective February 1, are as follows:

1. An extension of the time during which the company will pay for partial disability resulting from accidental injury from six weeks to a maximum of thirteen weeks.
2. The present aviation clause in the loss-of-time contract excludes non-scheduled flying. This clause has been liberalized, and the loss-of-time contract will now cover all commercial flying. Non-commercial flying is still excluded.
3. Under the present policy benefits are paid if accidental death or dismemberment occurs within 180 days after an accident. This period has been increased to 365 days.
4. The age up to which a member may carry the loss-of-time contract has been changed from his 70th birthday to the premium-due date following his 70th birthday.

A number of changes in the interest of providing better coverage for Society members have been made in the ASCE Group Disability Plan, since it was first set up almost eight years ago. Smith and Sternau, with offices in New York and Washington, are the administrators of the plan.

Canal Zone Governor Receives Registration Certificate

William E. Potter, M. ASCE, Governor of the Canal Zone, receives Certificate of Registration as a Professional Engineer from Col. Hugh M. Arnold, chairman of the Canal Zone Board of Registration for Architects and Professional Engineers and president of the Panama Section. The situation is unusual in that it was Governor Potter who, in his official capacity, established regulations governing practice in the Canal Zone. He was granted registration under the "eminence clause" of Canal Zone regulations. Other Registration Board members are (left to right) A. A. Mittag, civil engineer; L. B. Sartain, mechanical-electrical engineer; D. A. Yerkes, architect; and G. A. Doyle, architect and board secretary. The Canal Zone Board is the youngest registration body in the United States and her territories.

Research Prizes to Be Presented at Jackson Convention

Vinton W. Bacon

One of the pleasant features of the Jackson Convention will be the presentation—at the Governor's Luncheon on Tuesday, February 19—of the 1956 Research Prizes to three members: Vinton W. Bacon, executive secretary of the Northwest Pulp and Paper Association, Tacoma, Wash.; Fred Burggraf, director of the Highway Research Board, Washington, D. C.; and Chester P. Siess, research professor of civil engineering at the University of Illinois.

Mr. Bacon, who is honored for "achievements in applied research on waste water reclamation, pollution, and water quality," is a sanitary engineering specialist. From 1950 until December 15, 1956, when he took the Tacoma position, he was executive officer for the California State Water Pollution Control Board at Sacramento. His experience has also included two and a half years with the Los Angeles County Sanitary Districts as design engineer; three years (during the war) as a commissioned officer with the U. S. Public Health Service; and three years with the Orange County Sewerage Survey and Sanitation Districts. Mr. Bacon is a 1940 honors graduate of the University of California.

Mr. Burggraf is being honored for "his outstanding contributions to knowledge through the administration of research in highway engineering and construction materials." Educated at George Washington University, he began his career with the National Bureau of Standards and later was with the Illinois Highway Department, coordinating and standardizing cement-testing procedures. From 1929 to 1933 he was with the Highway Research Board, and from 1933 to 1940 with the Calcium Chloride Association. In 1940 he returned to the Highway Research Board, which he has served as assistant director, associate director, director, and editor.

Professor Siess is a 1936 graduate of Louisiana State University and holder of M.S. and Ph.D. degrees from the University of Illinois. With the exception of a year with the Louisiana Highway Commission, two years with the Chicago Department of Subways and Superhighways and a brief period with the New York Central in Chicago, he has spent his career at the University of Illinois and is now research professor of civil engineering. Professor Siess is honored for "his outstanding contributions to knowledge through his research on reinforced concrete slabs."

Fred Burggraf

Chester P. Siess

Seven Wonders Calendar

Officials of the Charles Bruning Company, Inc., suppliers of engineering and drafting equipment, came to ASCE Headquarters some weeks ago for pictures of engineering projects worthy of display on their calendar for 1957, one for each month. First recommendations, of course, were the Seven Modern Civil Engineering Wonders of the United States, selected by ASCE, to which were added five more projects that had been suggested for consideration during the selection of the "Seven."

Now, these attractive wall calendars have been printed, and the company generously offers a copy of it to any member desiring one. Inquiry should be made to any Bruning branch or distributor or to the Chicago office.

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the fifth of the month preceding date of publication)

Alabama Section Has Two-Day Annual Meeting

Exceptional public interest was shown in the Alabama Section's annual meeting held in Mobile, December 7 and 8. With talks and papers featuring projects of local interest, the Associated Press in Mobile gave complete coverage to the two-day program, which was also the subject of appreciative editorials.

Local interest was particularly keen in a panel discussion on "Development and Utilization of Alabama's Water Resources," moderated by Dr. Earl I. Brown, of Alabama Polytechnic Institute. The experts were Melvin R. Williams, of the U.S. Geological Survey, who spoke on the water resources of the state; Arthur N. Beck, of the Bureau of Sanitation, State Department of Health, who covered stream sanitation; Col. Harold E. Bisport, District Engineer at Mobile, who discussed river development; Charles M. Sanders, of the Soil Conservation Service, whose topic was watershed planning and management; Duncan C. Smith, of the Aluminum Company of America at Mobile, who dealt with present and future industrial water needs; and John A. Garrett, who rounded out the water resources picture with a résumé of legislation needed.

Some 200 members of the Section heard other papers: by C. D. Williams, of Patchen and Zimmerman, Augusta, Ga., on "Economic Studies in Selection of Bridge Types"; John C. Clarke, of J. B. Converse and Company, Mobile, whose topic was "Mobile's Water and River Board Makes an Intelligent Approach to Expansion"; and "Hurricane Problems in the Southeast," prepared by W. L. Dolive and delivered by Francis F. Escoffier, both of the Mobile District Office of the Corps of Engineers.

General Chairman Harold E. Bisport supervised arrangements for the outstanding meeting, which included trips to the manufacturing plant of the Southern Cen-Vi-Ro Concrete Pipe Company and a 30-mile cruise down Mobile Ship Channel to historic Dauphin Island, where members and their wives inspected the multi-million-dollar resort development underway.

President Mason Lockwood was guest of honor at a banquet held at the Fort Gaines Club. Other distinguished guests included all the ASCE Vice-Presidents—Messrs. Marston, Friel, Moore, and Holcomb; Director Graham P. Willoughby; Executive Secretary William H. Wisely; and Past-President William R. Glidden.

New Section officers, elected at the annual business meeting, are Kenneth C. Roberts, Mobile, president; Warren G. Keith, Tuscaloosa, first vice-president; John C. Clarke, Montgomery, second vice-president; and Jack Marshall, Mobile, secretary-treasurer. J. L. Land, of Montgomery, was elected to the Section's board.

ASCE President Mason Lockwood, Alabama Section President Raymond E. Strickland (center), and Col. Harold E. Bisport look over one of the outstanding technical papers presented at the Section's annual meeting.

Top-Flight Planning Marks Maryland Section Work

More Maryland Section members paid Section dues in 1956 than ever before in the Section's history. Announcement of this impressive new record—454 of 690 assigned to the Section paid—was announced by President W. Watters Pagon at a recent Section meeting which was attended by 205 members and guests. Consistently good meeting attendance is, in fact, a Section hallmark. Asked to comment on this desirable state of affairs, Secretary W. Worthington Ewell described the following five-point program for stimulating interest in Section affairs:

1. A regular schedule of monthly meeting dates is maintained. Thus members can plan to attend far in advance.
2. A "hospitality hour" precedes each meeting, giving those attending an opportunity to make new acquaintances and renew old ones. Over a period of years most of the active members have come to know one another and look forward to this monthly get-together.
3. Varied and timely meeting topics assure those attending a worthwhile evening. For instance, when plans were underway for the Patapsco Harbor Tunnel, Ole Singstad, Honorary Member of the Society and one of the world's foremost authorities on tunnels, spoke to 250 members and guests at a regular Section meeting.
4. One meeting each year is devoted to papers by members of ASCE Student Chapters at Johns Hopkins and the University of Maryland. In addition, students are encouraged to attend all Section meetings so that long before they become Junior Members they are in the meeting-going habit. Many who remain in the area after graduation feel themselves already an integral part of the Section.
5. All new members receive individually typed, personal letters of welcome

(Continued on page 70)

ASCE MEMBERSHIP AS OF JANUARY 9, 1957

Members	9,302
Associate Members	12,293
Junior Members	17,451
Affiliates	71
Honorary Members	44
Total	39,161
(Jan. 9, last year	38,396)

and an invitation to attend the next scheduled meeting. Congratulatory letters are also sent to those who are promoted to a higher grade of membership or achieve other distinction in the profession. This personal touch fosters the spirit of friendship and unity so necessary to the success of any organization.

Coming Events

Columbia—Host to a Local Section Conference, the Pacific Northwest Council Conference, and meeting of the ASCE Executive Committee, Walla Walla, Wash., April **25-27**.

Hawaii—All-day annual conference at Waikiki, Oahu, on May 15. Irrigation will be the conference theme.

Metropolitan—Meeting in the Engineering Societies Building, New York, February 20, at 7:00 p.m. Meeting of the Junior Forum in Room 502, February 13 and March 6, at 7:00 p.m. Frank W. Herring, deputy director of planning for the Port of New York Authority, will address the February meeting, and Dan Morris and Gardner Reynolds will give an illustrated talk on foreign construction at the March meeting.

Scheduled ASCE Conventions

JACKSON CONVENTION
Jackson, Miss.
Hotel Heidelberg
February 18-22, 1957

BUFFALO CONVENTION
Buffalo, N. Y.
Hotel Statler
June 3-7, 1957

ANNUAL CONVENTION
New York, N. Y.
Hotel Statler
October 14-18

L. G. Feil (left), 1956 president of Kansas City Section, hands the reins to his successor, W. G. Riddle, elected president for 1957 at the Section's December meeting. Mr. Riddle—a partner in Haskins, Riddle & Sharp, hydraulics, water supply and sewage consultants—will work on the assumption that even greater efforts must be made to attract young civil engineers to the profession. Elected with him at the December meeting were Ronald M. White and Jack F. Daily, vice-presidents, and L. M. Bremser, secretary-treasurer.

The **Anchorage Branch** of the **Alaska Section** installed the following new officers at its annual dinner meeting on December 3: Oliver V. Kola, president; D. Boyd Slawson, vice-president; and Arthur R. Jacobs, secretary-treasurer. All live in Anchorage. In the featured talk Mrs. Ernest R. Boyd told her distaff listeners "How to Live with an Engineer—and Like It." Engineers' wives, she advised, should not put their roots down too deep, as they will almost invariably have to move. It was Mrs. Boyd's conclusion that, "although the engineer is a dedicated man who may at times put his work slightly ahead of his family, that same dedication makes him the ideal husband and father." At another meeting members of the Branch heard Roger Allin, of the U.S. Fish and Wild Life Service, discuss the operations of the Service in Alaska. A plan is in progress, he told them, "to set aside parts of the public domain as reserves and parks for the future state of Alaska."

For its second meeting the recently established **Phoenix Branch** of the **Arizona Section** heard H. R. Burt, of the AiResearch Manufacturing Corporation, speak on problems of modern aircraft passenger comfort. The Branch now has twenty subscribing members, but expects to gain many more soon. A group of members recently donated their services for a complete architectural survey and preparation of plans for a new Salvation Army building in Phoenix.

The Federal Highway Act of 1956 in its effect on municipalities proved a popular topic at a recent meeting of the **Central Illinois Section.** F. L. Anthony, regional engineer for the U.S. Bureau of Public Roads, was featured speaker. New Section officers, installed at the annual meeting on December 18, were Junius R. Gardner, Decatur, president; Ellis Danner, Urbana, first vice-president; Paul L. Zumwalt, Peoria, second vice-president; and William J. Hall, Urbana, secretary-treasurer.

Soil and foundation problems encountered in the many Great Lakes cities were analyzed at the **Cleveland Section's** December meeting by W. S. Housel, professor of civil engineering at the University of Michigan and authority on soil mechanics. Because of the geology of the area the problems discussed were quite similar, involving an analysis of the "mass stability" of a deep layer of soft, plastic clay when a large building, an ore dock, a blast furnace, or other heavy structure is contemplated in the area. In answer to the criticism of engineers who feel that small core samples cannot be expected to give accurate results, Professor Housel showed how in several cases actual field results confirmed laboratory tests. He stressed the fact that steel companies with foundation problems could solve many of their own problems if they would keep accurate field data on the vertical and lateral movements of their structures over a period of time.

At the helm of the **Colorado Section** for the coming year are Dewey S. Wright, president; Emerson S. Ellett, vice-president; and Leo C. Novak, secretary-treasurer.

The theme of the Pacific Northwest Council Conference, "Men Plus Resources Equals Progress," is expected to attract the interest and attention of all concerned in the development of the region. To be held in Walla Walla, Wash., April **26** and **27**, with the **Columbia Section** as host, the conference will be preceded (on April **25**) by a Local Section Conference for all Sections in the Northwest. Announcement of major speakers, in addition to talks by the members of the ASCE Executive Committee who will meet the first day of the conference, is expected shortly. Already planned is a hard-hat tour of McNary Lock and Dam, with an additional excursion to the site of Ice Harbor Lock and Dam on the Lower Snake River for those hardy souls who want to see the initial construction stages of a similar project. Planning for this important spring meet is the first task of the new Section officers: E. C. Franzen, president; O. A. Lewis, first vice-president; C. N. Zangar, second vice-president; N. F. Meadowcroft, secretary-treasurer; and V. E. Nutley, director. General conference chairman is B. Loyal Smith, 903 E. Alder Street, Walla Walla, Wash.

New Kentucky Section officers are, in usual order, D. H. Sawyer, secretary-treasurer; W. B. Drake, president; W. L. Echstenkamper, vice-president, and R. C. Deen, corresponding secretary.

Featured speaker at a joint meeting of the **Connecticut Section** and the New Haven section of the ASME, held at Hamden on December 5, was Ray M. Boynton from the office of D. B. Steinman. Mr. Boynton gave an illustrated talk on the New Haven portion of the Connecticut Turnpike, covering the Quinipiac River Bridge and the Oak Street Connector. He also showed progress views of the Mackinac Bridge. Proposed changes in the Connecticut Registration Act, which would allow the practice of engineering in the state under partnership or corporate types of business organizations, are being studied by the Section.

Harold Colee, executive vice-president of the Florida Chamber of Commerce, addressed the **Florida Section's** annual meeting—held in Jacksonville on December 8—on the growth and development of the state. Life Membership Certificates were presented to Samuel F. Tapman, Jacksonville Beach; C. Paulding Rhynus, Daytona Beach; and Gerald M. Keith, Gainesville. Hubert F. McDonell, of Gainesville, is new Section president; Byron D. Spangler, of Gainesville, vice-president; and John T. Potts, Jr., of Jacksonville, secretary-treasurer. New **Gainesville Branch** officers are R. W. Pride, president; C. C. Hill, vice-president; and Donald A. Sawyer, secretary-treasurer. For the **Jacksonville Branch** the new slate is James F. Kanipe, president; Brown L. Whatley, Jr., vice-president; and Wilbert S. Eisenberg, secretary-treasurer. The **West Coast Branch** has elected Timothy E. Goodrow, president; Mosely C. Collins, Jr., and Robert H. Grady, vice-presidents; and Frank L. Lanius, secretary-treasurer. **Northwest Branch** elections have not been announced.

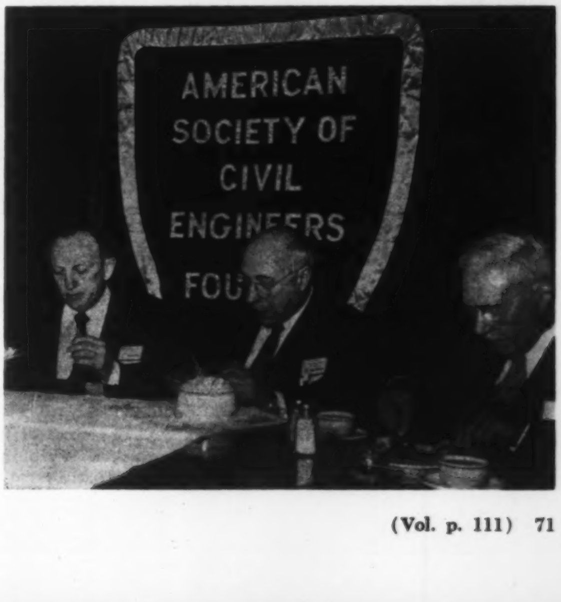
Georgia Tech Student Chapter members—Ronald Ridgway and James M. Barker—led off the technical program at the **Georgia Section's** annual meeting held in Atlanta on December 8. A panel discussion on highways was moderated by Moses E. Cox, with B. P. McWhorter, R. Paquette, H. E. Newton, and M. L. Shadburn the experts. ASCE President Mason Lockwood was principal speaker at the evening banquet with a talk entitled "Growing Pains in Engineering." Vice-President Francis Friel, Director Graham P. Willoughby, and Executive Secretary W. H. Wisely spoke briefly on various phases of Society affairs. Life Membership Certificates were presented to Eugene V. Camp, Harry S. Gibboney, Charles M. Thomas, and Samuel R. Young. A photo of the Section's new officers, installed during the meeting, appeared in the January issue (page 86).

ASCE Director R. Robinson Rowe discussed recent Society activities at the **Intermountain Section's** annual meeting in December. The technical program consisted of a film and talk on the Weber Basin construction project given by Harold Dean, of the Weber Basin Office of the Bureau of Reclamation at Ogden. During the evening results of the Section's balloting for new officers were announced: Ralph E. Spears, president; Vaughan E. Hansen, vice-president; and Warren D. Curtis, secretary-treasurer (for two years). Retiring President Dean K. Fuhriman was presented with a jeweled tie clasp from the Section as a token of its appreciation of his services.

Recently elected officers of the **Lehigh Valley Section** are Rollin B. Foster, Bethlehem, president; Robert De Moyer, Easton, first vice-president; John M. Adams, Allentown, second vice-president; and Donald R. Werley, Allentown, secretary-treasurer.

In the **Los Angeles Section** it is N. D. Whitman, Jr., for president; Harald Omsted and Dean E. Stephan, vice-presidents; Samuel B. Nelson, secretary (elected for the two-year term, 1957-1958); and Alfred E. Waters, treasurer, who will complete the second year of a two-year term. Duly elected officers of the Santa Barbara-Ventura Counties Branch are J. Edward Sheehy, Ventura, president; Sterling Bugg, Port Hueneme, vice-president; and George Conahey, Port Hueneme, secretary-treasurer.

In December the **Mexico Section** took part in a joint meeting that brought together Mexico sections of all the Founder Societies, with the AIEE as



ACSE President Mason Lockwood was featured speaker at the Illinois Section's annual dinner meeting, which was attended by over 100. He is shown here with retiring Section President C. J. McLean and Albert F. Reichmann (at far right), past-president of the Section and one of the Society's oldest members. H. F. Sommerschield is new Section president.

host. Guest of honor and speaker was Bayard L. England, president of the Atlantic City Electric Company, who ably discussed "The Engineer in the Electric Utility Industry." The all-societies get-together, first of its kind held in Mexico, is being planned as an annual event. At another recent meeting Mexico Section members heard their fellow member Gustavo L. Hamirez and D. Rozeboom, manager of "Cimentaciones, S.A." give an illustrated talk on Vibro Piles. Mr. Rozeboom has worked with this type of pile in Europe, Asia, and South America, and is now testing them in Mexico.

Highway engineers meet at University of Maine for seventh annual Maine Highway Conference, held December 14 and 15 under sponsorship of the Maine Section, the Maine Highway Commission, and the University of Maine Student Chapter. Speakers (shown here, left to right) were Stanton Walker, engineering director, National Ready-Mixed Concrete Association, Washington; Carl A. Carpenter, assistant physical research chief, U. S. Bureau of Public Roads, Washington; Vaughan M. Daggett, chief engineer, Maine Highway Commission, Augusta; John Hogan, consulting structural engineer, Portland Cement Association, New York; Charles F. Parker, Gorham, president of Maine Section; A. T. Goldbeck, engineering consultant, National Crushed Stone Association, Washington; Norman W. McLeod, asphalt technologist, Imperial Oil Ltd., Toronto; and John M. Griffith, research engineer, Asphalt Institute, College Park, Md. The Maine Good Roads Association prize of $25 for the best Section paper, went to Andrew Adams, research engineer for the Maine State Highway Commission, and the New England Road Builders' Association award of $25 for the best Student Chapter paper went to John S. McCormick, Jr., a college junior.

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PHILADELPHIA
1877

Philadelphia Section, at its meeting on January 8, presented Life Membership Certificates to six members. Reading from left to right, they are Edward S. McClintock, Charles H. Howland, Edward H. Maier, Ellwood H. Aldrich, Mrs. Harry S. Nagin (who received the award for her husband who was attending a meeting in Washington, D. C.), ASCE Vice-President Francis S. Friel, who presented the awards, Fred G. Schworn, Section President Victor G. Thomassen, and Secretary Clyde B. Pyle. Edward S. Burwell, Jr., chief of the Soil Mechanics and Geology Branch, Office of the Chief of Engineers, Washington, spoke on the subject, "The Impact of Geology on Civil Engineering."

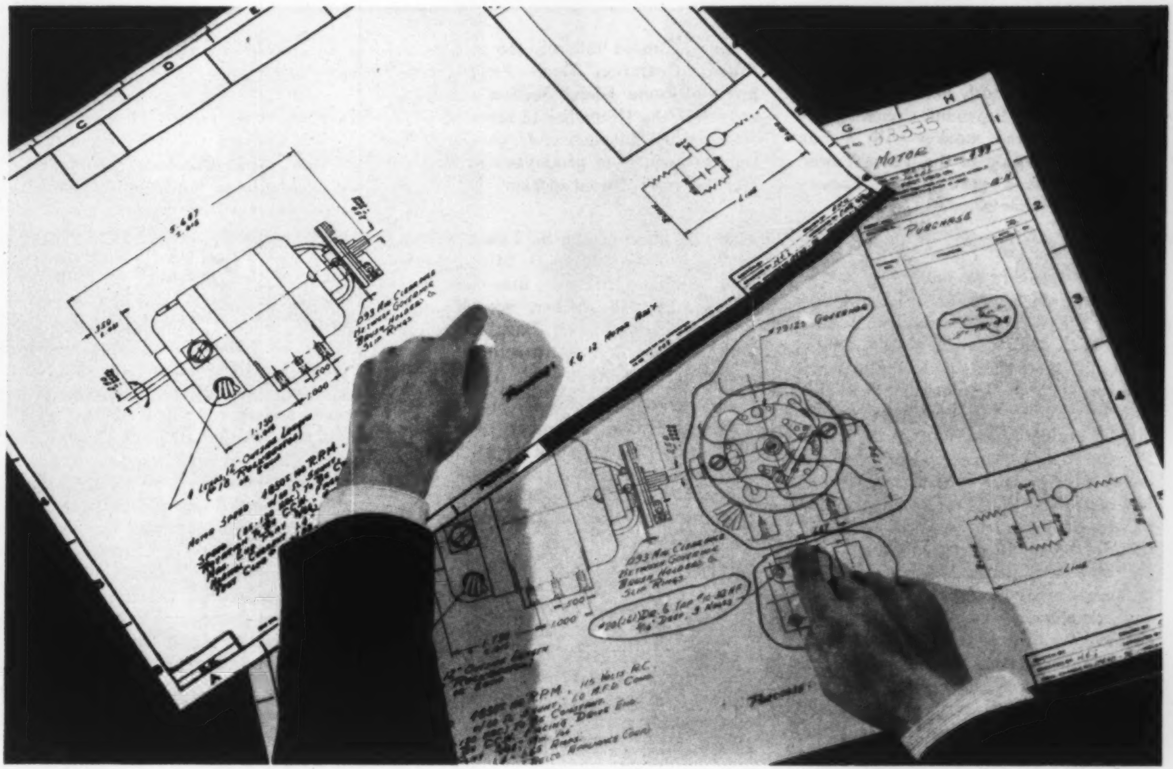
Successful and interesting joint meetings with Student Chapters are reported by the **Michigan Section,** which met with the Michigan State University Chapter at East Lansing in November and the Wayne and University of Detroit Chapters in Detroit in December. Commending the work of the Chapters in planning and conducting the meetings, the Section calls it proof "that students of the very highest type will soon become civil engineers." Through its Vocational Guidance Committee and the Engineering Societies of Detroit, the Section is considering ways of stepping up its vocational guidance program with the aim of increasing the influx of young recruits into the profession. At its January meeting the Section installed the following new officers: Lloyd T. Chaney, president; Elihu Geer, first vice-president; Carl Johnson, second vice-president; and Leonard L. Klein, secretary-treasurer. The new Life Members are Wayne L. Arnold, Earnest Boyce, John G. Claybourn, Harold H. Carson, Donald M. Hatch, Joseph B. Jewell, Harry E. Miller, James R. Pollock, Walter C. Russell, and Frank R. Theroux.

An interesting talk on words and their use, with special attention to the language of science, constituted the technical program at a recent joint meeting of the **Mid-Missouri Section** and the University of Missouri Student Chapter. The speaker was Herman Betz, professor of mathematics at the university.

Two new Kansas City bridge projects—the Paseo Bridge and the Broadway Bridge—were described at a recent meeting of the **Nebraska Section** by C. Robert Swanson, field engineer on the $18,000,000 Paseo Bridge and project engineer on the $13,000,000 Broadway Bridge. Mr. Swanson is connected with Howard, Needles, Tammen and Bergendoff, designer of both projects.

The **Northwestern Section's** new slate of officers is J. E. Fant, president; C. H. Prior, first vice-president; John E. Meyer, second vice-president; and Norman E. Henning, secretary-treasurer. For the Section's **South Dakota Branch** the lineup is Neil Bergstreser, president; George Jacobson, first vice-president; Jack Blaess, second vice-president; and Frederick R. Heartz, secretary-treasurer.

To the list of **Oregon Section** officers for 1957 appearing in the January issue (page 90) there should be added the name of the new treasurer, John T.



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Merrifield. The new slate was installed at the Section's annual meeting on December 13. Alf Hjort, northwest district manager for the Raymond Concrete Pile Co., was featured speaker with a talk on the construction of the Texas Tower, which will be a part of our Eastern Air Defense radar system.

Recent speakers at joint meetings of the **Pittsburgh Section** and the Engineers Society of Western Pennsylvania have been T. J. Dolan, head of the department of theoretical and applied mechanics at the University of Illinois, and Edward Fraher, executive director of the Public Auditorium Authority of Pittsburgh and Allegheny County. Speaking on the "Fatigue of Structures" at the November meeting, Professor Dolan emphasized the need to give proper attention to the detailed design of machines and structural parts. This, he said, will minimize or avoid fatigue failures. Mr. Fraher's subject was structural and mechanical features of the new auditorium, which is now getting under way. William R. B. Froehlich is 1957 Section president, and Ralph B. Horner vice-president. The new directors, elected for a three-year term, are Ernest C. Hartmann, Robert B. Pease, and Thomas E. Stelson (Junior Member). Merritt A. Neale continues as secretary-treasurer.

An illustrated talk on the Antarctic, called "Operation Deep Freeze," engrossed **Rhode Island Section** members attending the December 13 meeting. The Rev. Daniel Linehan, S.J., chairman o the department of geophysics at Boston College, was featured speaker.

At the helm of the **St. Louis Section** in 1957 will be Eldred B. Murer, president; Verner C. Hanna, first vice-president; Henry S. Miller, second vice-president; Robert D. Bay, secretary; and Lawrence P. Roth, treasurer.

San Diego's critical water problem was discussed at the December 18 meeting of the **San Diego Section** by M. J. Shelton, deputy director of the State Department of Water Resources. Mr. Shelton's talk, entitled "Year of Decision for San Diego's Water Future," covered the Feather River Project and summarized the different engineering studies that have already been completed. Mr. Shelton told the group that it was up to informed people, such as Section groups, "to educate the general public on our critical need for water and the ways and means of getting it."

A five-member **San Francisco Section** Committee on Rapid Transit reported at the Section's December meeting after a six-month special study of proposals submitted to the San Francisco Bay Area Rapid Transit Commission by Parsons, Brinckerhoff, Hall and Macdonald and by the Stanford Research Institute. After Chairman George Whittle had outlined the situation, the other committee members reported under the following heads: "Financing from Revenues and Taxes" by Prof. Harmer E. Davis, of the University of California; "Should We Start the System More Slowly Than Now Proposed?" by Arthur C. Jenkins, consulting engineer; "How Will the Peninsula Be Affected?" by Joseph G. Hunter, consulting engineer and retired chief engineer of the California Public Utilities Commission; and "The Optimum vs. the Minimum Plan for Trans-Bay," by John A. Morin, city engineer of Oakland. Results of the annual election of officers, announced at the meeting, are H. Christopher Medbery, president; William W. Moore, senior vice-president; Harmer E. Davis, junior vice-president; Bernard A. Vallerga, secretary; and Ben C. Gerwick, Jr., treasurer. William A. Penny will be president of the Junior Member Forum.

New **Spokane Section** officers are Ken Norrie, president; Edwin Nasburg, first vice-president; John P. Esvelt, second vice-president; and Daren W. Johnson, secretary-treasurer.

A double-barreled program, recently put on by the **Tacoma Section,** consisted of a panel discussion on the Tacoma-Seattle-Everett Freeway, moderated by William A. Bugge, and another in a series of Junior Member papers being presented in competition for a cash prize donated by the Section. This most recent Junior Member presentation was by Hollis R. Goff, senior associate bridge engineer for the Washington State Highway Department, on the subject of heat straightening of structural steel members. The panel members included R. H. Kenyon, chief engineer of plans and contracts; C. K. Glaze, principal planning engineer; and E. C. Simpson, construction engineer. Recent Board actions were discussed by Louis E. Rydell, ASCE Director for District 12.

Featured speaker at a recent meeting of the **West Virginia Section,** held in Huntington, was Col. H. J. Skidmore, of the Army Corps of Engineers, who reported on the work currently under way at the Waterways Experiment Station. H. E. Kirby, a recent transfer from the Virginia Section, presented a committee report of that Section on the "Economic Status of the Engineer."

At the helm of the Tennessee Valley Section for 1957 is this new Board of Directors, which held its first meeting on December 8 at the home of the new president, Henry C. Peeples, in Chattanooga, Tenn. Shown left to right, seated, are Charles D. Durfee, secretary-treasurer of the Section; President Henry C. Peeples; and George P. Palo, past-president of Section. Standing, in same order, are John W. Minchey, president of the Oak Ridge Branch; Hendon R. Johnston, president of the Holston Branch; Francis T. Thompson, president of the Chattanooga Branch; Robert R. Brookshire, 1957 Section vice-president; Myron O. Jensen, president of the Asheville Branch; and William M. Paxton, Jr., president of the Muscle Shoals Branch. John L. Neely, Jr., president of the Knoxville Branch was not present when the picture was taken.

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BY-LINE WASHINGTON . . . . .

The United States, still growing by leaps and bounds, in one of its greatest eras of expansion, will rely heavily this year on the men who design and build the new facilities needed by a growing population and a prosperous economy. New homes, schools, hospitals, churches, office buildings, industrial plants, highways, airports, water and sewage works must be constructed at a record pace again this year. Along with military facilities, flood control and other public works projects, the construction job cut out for civil engineers will top an estimated $46.4 billion. This will be 5 percent over last year's volume.

* * *

Public construction will spark much of the increased engineering activity. A 12 percent boost—from $13.4 billion to $15.0 billion—is expected. This compares with a 2 percent increase in private construction—from $30.7 billion to $31.4 billion. Some of the highest jumps will be in: Public housing—up 64 percent; hospital construction—up 23 percent; sewage facilities—up 23 percent; conservation construction—up 21 percent; water supply facilities—up 16 percent; school construction—up 11 percent; highways—up 8 percent; and military facilities—up 7 percent.

* * *

1957 will be marked by the opening of yet another engineering construction market. The new program of federal aid for construction of sewage treatment systems is nowhere near as dramatic as the superhighway program, but the foundation of federal assistance approved by Congress last year is expected to be only the beginning.

* * *

An estimated 10,000 communities already lack proper pollution control facilities, and at least $22.2-billion worth of new construction will be needed over the next 20 years, the Department of Commerce estimates.

The Public Health Service started last month to authorize grants from the sum OK'd by Congress—$50 million a year for the next three years. With the local matching funds required, however, the total construction envisioned will be more than three times these amounts.

Roadbuilding will provide the greatest engineering market, dollarwise, in the public works category, accounting for $5.5 billion (not including right-of-way costs), nearly 37 percent of all public construction. Under the stimulus of the $50-billion federal-state program drafted by Congress a few months ago, roadbuilding is expected to become the largest single field of endeavor for civil engineers. The federal-state program to construct a 41,000-mile superhighway system and to modernize the rest of the 700,000-mile federal-aid highway network will boost the total roads and streets improvement market to nearly $100 billion over the next 13 years.

* * *

Other construction in 1957 includes these plans:

The Bureau of Reclamation will spend about $714 million this year for projects ranging in size from the 30-million-cu yd earthfill Trinity Dam in California to the 400,000-cu yd Howard Prairie Dam in Oregon. Some 86 jobs will be let before June, including seven large earth dams, one large concrete dam, three bridges, 20 miles of major tunnels and conduits, nearly 530 miles of drains and canals, 40 miles of pipelines, 16 pumping plants and four power plants.

The Army will invest another $2 billion in engineering and construction this year.

* * *

The first progress report of the President's comprehensive survey of public works planning has been filed by his special assistant, Maj. Gen. J. S. Bragdon. Concerned about the absence of coordination in this area, General Bragdon called public works planning "a sprawling monster with many heads and arms reaching into every phase of our everyday life." Administered by some 40 agencies of the federal government and over 100,000 lower governmental jurisdictions, he said, "Neither heads nor arms of all concerned act with reference to each other unless constrained to do so."

He proposed closer coordination between all levels of government. State units could be formed, he said, to keep legislatures informed of how state programs would fit in with the federal program. Cities could create similar planning units to apprise mayors and city councils of future needs. More specific recommendations will be made soon. In the meantime, the general's staff will continue its inventory of all the nation's public works needs.

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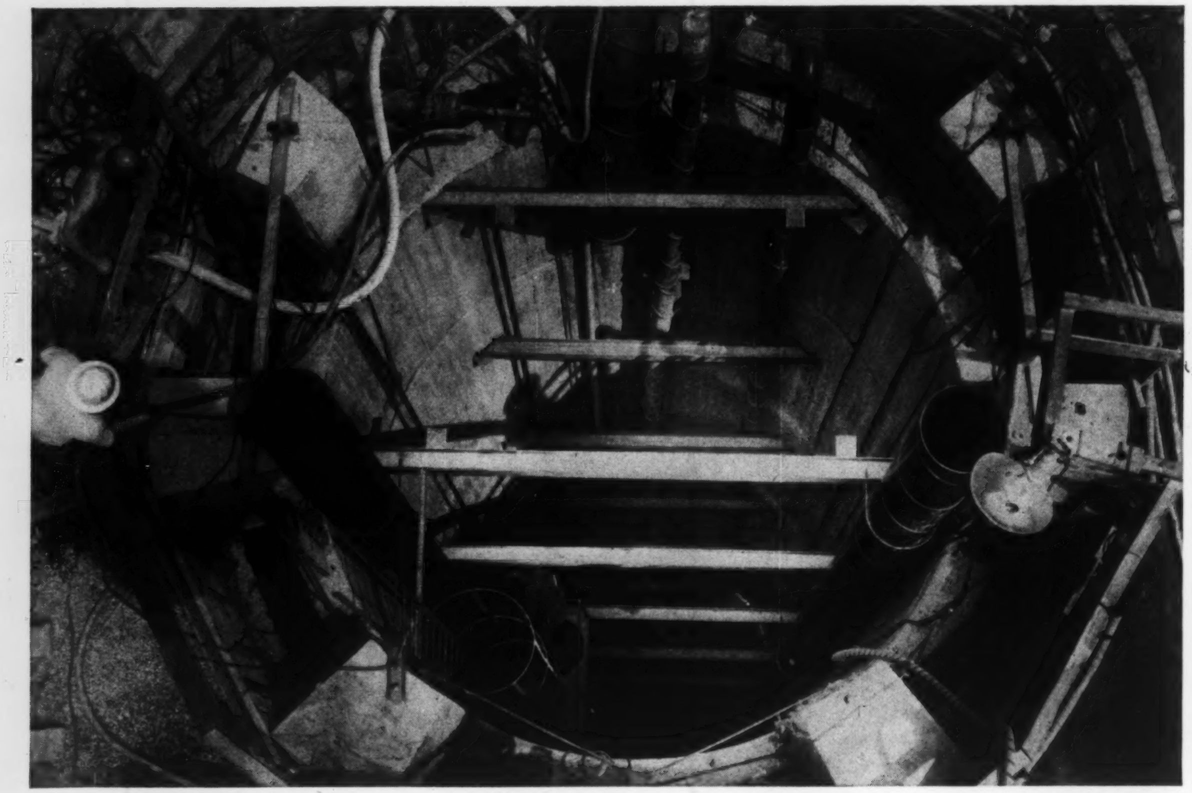

Photo, courtesy Pittsburgh Post-Gazette

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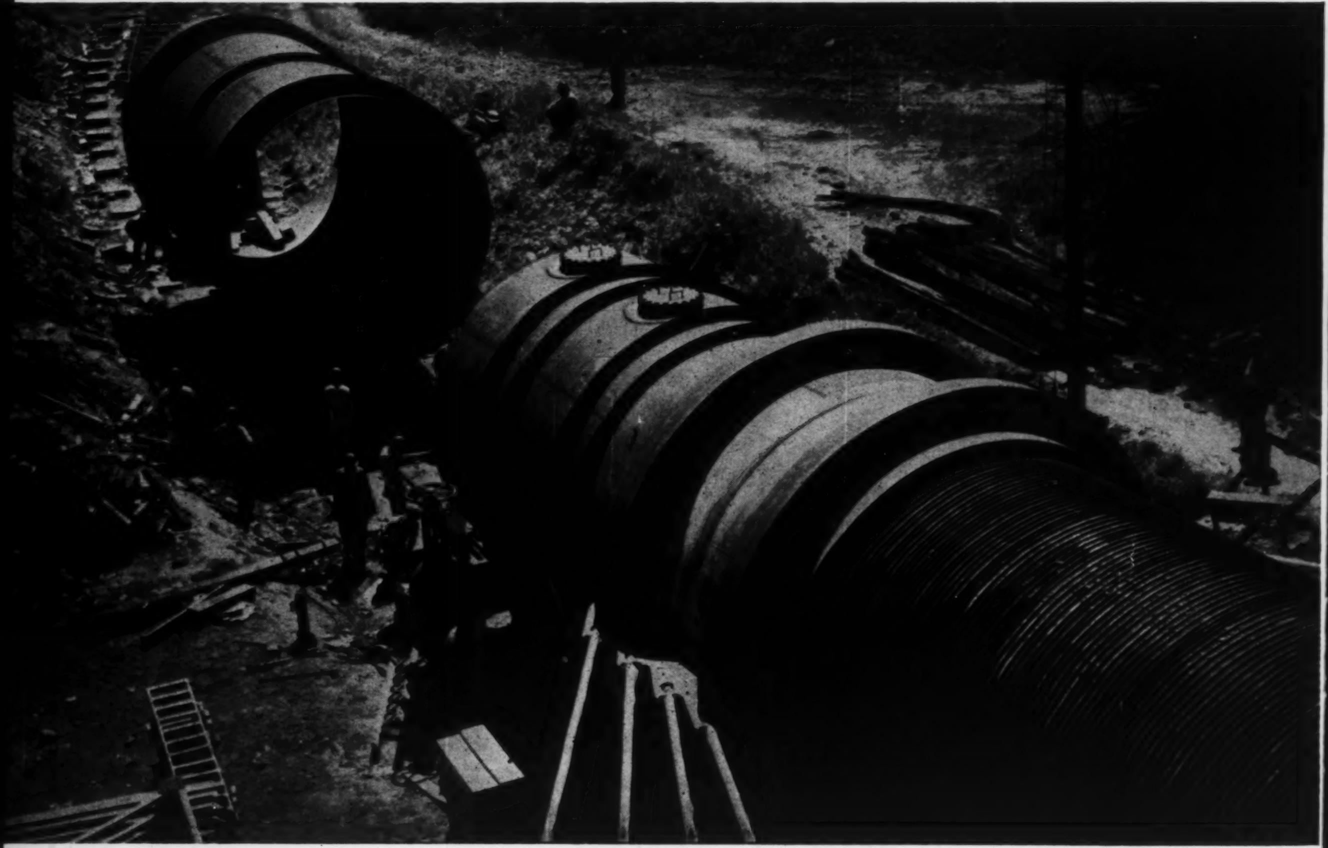

The first pipe to be erected is shown being readied for connecting to the bulkhead section. Eight heat-treated tie-rods, anchored to huge "drags," or counterweights, hold the bulkhead steady against a static head of 23 psi and a thrust load of 560,000 lb.

High in the Pocono mountains of northeastern Pennsylvania lies Lake Wallenpaupack, largest lake wholly within the state. Long popular for fishing and water sports, Lake Wallenpaupack is less well known to the public for the reason it was created—as a source of water for a Pennsylvania Power & Light Company hydro-electric generating station.

When the utility constructed the lake 30 years ago, they built a mammoth wood-stave pipe line, approximately 15 ft in diameter, from the dam face 3½ miles to the hydro-electric plant. It was the world's largest wooden tube for its length at the time. Bethlehem supplied nearly 4,000 tons of circumferential steel rods, fittings and saddles for this line.

In recent years, the condition of the wood reached a point where it was no longer economical to continue maintenance on the lower 8500-ft length of the wooden line. It was decided to substitute steel pipe. The contract for design, fabrication and erection of a 14-ft 8-in. diam line was awarded to Bethlehem.

Well-equipped Shop

Field work began in early Spring of 1956 when Bethlehem set up a full-scale fabricating shop along the right-of-way. Hoisting equipment included a 30-ton guy derrick with three-drum electric hoist, four truck cranes and a tractor hoist. Welding operations required three submerged-arc welding machines, 44 electric and 32 gasoline and diesel welding machines, three mobile generators and four mobile compressors. The Bethlehem working force numbered well over 200 men at times.

With the shop ready for business, curved plates, ⅜ in. thick and in 32- and 40-ft lengths, began arriving from our Steelton, Pa., plant. Five were required for each section of pipe. The shorter plates were used for the numerous bends; the 40-ft plates for tangent pipe.

-Stave Line

Demolishing the old wood line. About one-half of the saddles were re-used for the steel pipe.

Assembly of each pipe length began with fitting-up, using special falsework jigs to assure true diameter. Then came automatic welding of longitudinal seams, mitering the pipe ends where necessary to provide for changes in direction, beveling in preparation for butt-welding, and welding on of external stiffener rings. Welds to be subjected to pressure were radiographed.

Meanwhile, the entire wooden line was emptied, a pre-fabricated steel bulkhead was installed, and the section of the wooden line not being replaced was filled with water to preserve the wood during the construction period. Then began demolition of the lower portion of the wood stave line.

"Railroad" Speeds Erection

The pipe lengths, weighing 20 tons in the case of the 40-ft tangent sections, were hauled from the storage yard over a specially built track. A small but powerful gasoline locomotive pushed the lengths quickly into place where they were jacked off the cradle truck and into the precise position for welding. Highly skilled welders made the necessary passes on the circumferential joints. A subcontractor handled the application of protective lining and coating materials to the pipe.

Upon completion of the new portion of the pipe line, the old section was emptied of water. This permitted workmen to enter the bulkhead section and cut away the steel diaphragm. Finally the dam gates were opened, allowing water to rush through the line and start PP&L's powerful turbines humming once again.

Bethlehem is an old hand at the design, fabrication and erection of large-diameter pipe for hydro-electric and industrial plants, as well as municipal water-supply systems. For more information, please contact the Bethlehem sales office nearest you.

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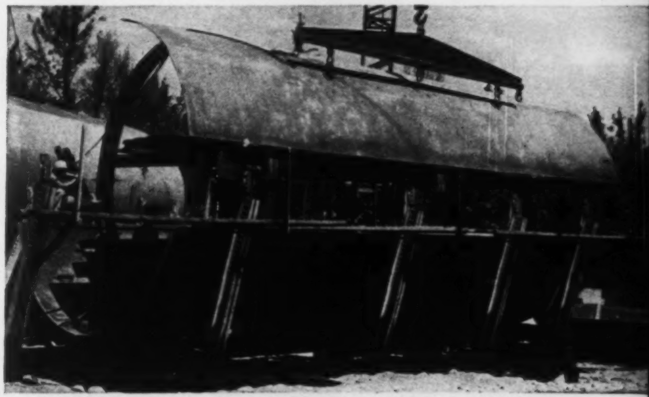
Formed plates, the assembling and welding operations, and storage of finished pipe, can be seen in this view of the fabricating yard.



The plates were fitted up, then tack-welded prior to welding by the automatic submerged-arc method. Stiffener rings were attached later.

Rolling scaffolds permitted three welders to work a single joint simultaneously from the inside. Weld passes were also required on the outside of the giant tube.

A portion of the nearly completed welded-steel line.

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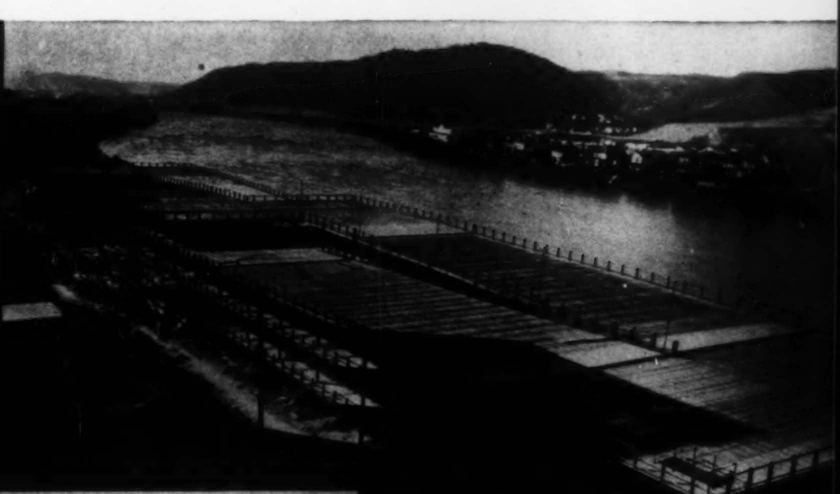

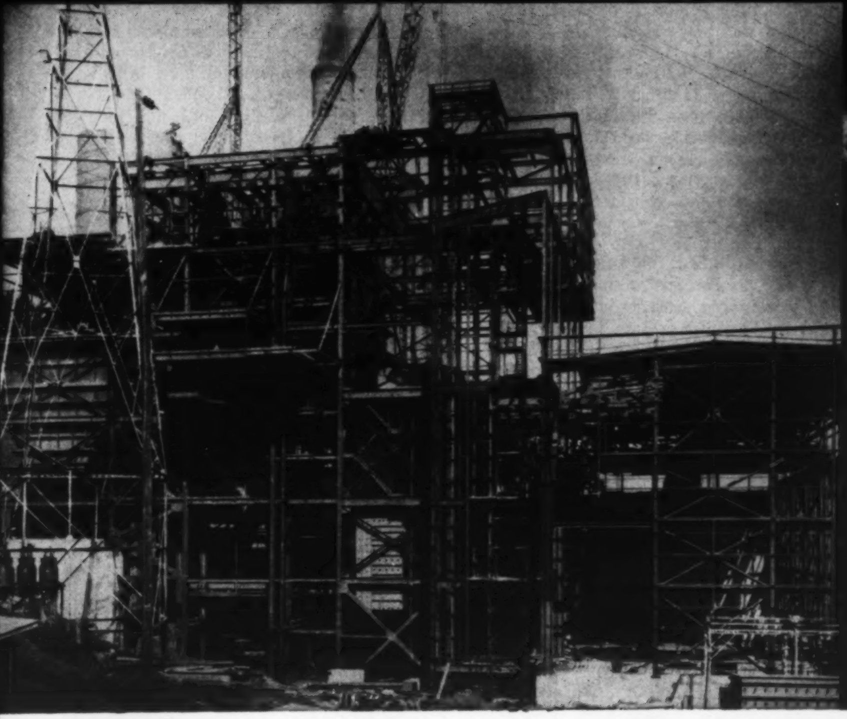

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NEWS BRIEFS . . .

New Construction Volume for 1956 Put at $44.1 Billion

Smashing dollar-volume records for the eleventh consecutive year, construction activity in 1956 totaled an estimated $60.6 billion in the continental United States, and the 1957 potential indicated at the end of the year was for more than $64 billion. This is the estimate of the Associated General Contractors of America in its year-end review and outlook. The AGC, which represents more than 6,700 leading construction firms, bases its release on a study of authoritative private sources and official government estimates.

The 1956 total, which includes $44.1 billion in new construction and $16.5 billion in maintenance and repair of existing facilities, represents an increase of about 3 percent over the revised $58.9 billion put in place during the spectacular construction year of 1955. As the nation's largest single production activity, construction accounted for nearly 15 percent of the gross national product, when the government's investment in overseas construction is added, and directly and indirectly for about 14½ percent of the country's total employment.

According to the AGC, construction received such an impetus from the unprecedented 1955 levels that it continued strong through most of the year, despite a sagging residential market resulting from competitive credit conditions. By the year's end there were signs that tight credit was also restricting other types of construction.

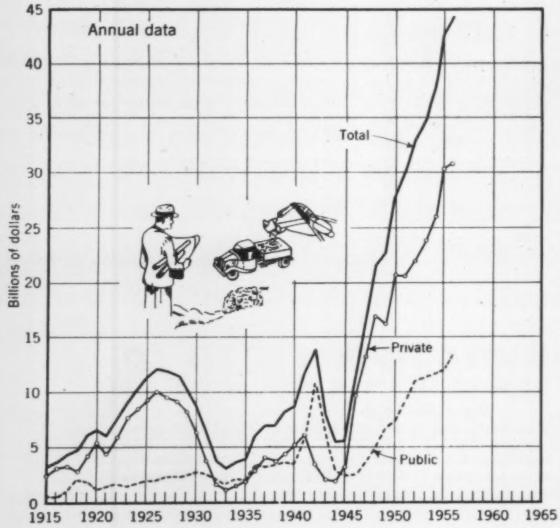
The 3 percent increase in dollar volume over 1955 was more than offset by an increase of about 5 percent in construction costs. Aside from the decline in housing, construction volume was probably prevented from increasing by a general shortage of structural steel—the result of the summer strike—plus spot shortages of Portland cement in some areas during the peak construction months.

The volume of new construction in 1956 is broken down into $30.7 billion in private construction and $13.4 billion in public projects. The decline (of 8 percent) in dollar volume of residential construction was more than offset by dramatic increases in non-residential work. While private volume, depressed by housing, increased by only 1 percent in the aggregate, non-residential building rose 15 percent to a total of $8.7 billion, paced by a 10 percent increase in commercial construction (at $3.3 billion) and a 25 percent jump in industrial building (totaling $3.1 billion). Public utilities also continued to expand, with outlays rising 10 percent to a total of $8.8 billion.

In the public construction field, state and local public works continued dominant for the fifth successive year, with this category accounting for an estimated 72 percent of the $13.4 billion public total which was 8 percent above the 1955 record. Highway construction rose 13 percent to more than $5.1 billion; public school outlays expanded 5 percent to $2.6 billion; and sewer and water facilities jumped 19 percent to $1.3 billion. Hospital and institutional building continued to decline.

In the primarily federal categories, military construction increased 9 percent to 1.4 billion, and conservation and development increased 12 percent to $660 million, reversing a downward trend which began in 1950. There was a drastic decline in industrial building—primarily atomic energy facilities—which dropped 40 percent from 1955 to $425 million.

In 1957, as the AGC sees it, there will be a continuing demand for all types of non-residential construction, "with the business sector planning a continued high level of capital outlays, local public bodies straining to meet accumulated and future community facility needs, and with financing problems foremost in carrying out the potential." With the exception of structural steel, most materials are expected to be in adequate supply as new plant capacity comes into production.



Construction activity for 1956 breaks dollar-volume records for the eleventh consecutive year with a total of $60.6 billion for the continental United States. This total includes $44.1 billion in new construction and $16.5 billion in maintenance and repair of existing structures.

Venezuela to Have Big-Inch Oil Line

Clearing of the right of way has begun for Venezuela's longest "big-inch" oil line. Williams Brothers, of Tulsa, Okla., has been awarded the contract to build the 212.5-mile, 20-in. crude pipeline for Socony Mobil Oil Co. de Venezuela. Connecting the San Silvestre field, southeast of Barinas, and Puerto Cabello on the Caribbean coast, the $25,000,000 line will open up the country's third major producing area, the Barinas-Apure basin.

The bare pipe will be laid on concrete sleepers 1 ft above the ground. However, it will be coated and wrapped for river and road crossings, and magnesium anodes will protect the river crossings. The biggest construction problem will be the rainy season, mid-April to December, when rains in the area average 100 in. To speed up the work, which is scheduled for completion in July, two camps of portable aluminum buildings will be maintained by the contractor—one to provide the crew with living quarters while the other is being set up at the next location.

The engineers are the Magnolia Petroleum Co., a Socony affiliate.

Salt-Water Encroachment In Dade County, Florida

Encroachment of salt water into the sole source of fresh ground water for Dade County, Florida, is due in large measure to the system of uncontrolled or inadequately controlled tidal drainage canals, according to a report just released by the U.S. Geological Survey. The fresh ground-water source is the Biscayne aquifer, a wedge-shaped mass of highly permeable limestone and sand which attains a maximum thickness of about 120 ft in the coastal area of Dade County. Since no other source of fresh ground water exists in the county, salt-water encroachment in the aquifer is of considerable concern to this populous area.

According to the report, uncontrolled tidal canals cause salt-water encroachment in the Biscayne aquifer in two ways: (1) They drain off fresh ground water, thereby reducing the fresh-water head that opposes the inland movement of salt water in the aquifer, and (2) they provide a path for the sea water to move readily inland during dry periods. Inadequately controlled canals are those in which the control structures have been placed too far inland to be effective in preventing or retarding excessive salt-water encroachment, the report declares.

The report, entitled "Salt-Water Encroachment in Dade County, Florida," was prepared by Howard Klein, of the Geological Survey, in cooperation with the Florida Geological Survey, Dade County, and the cities of Miami and Miami Beach. It may be inspected at the U.S. Geological Survey, Room 1242-G, General Services Administration Building, Washington, D.C.; Dinner Key, South Bayshore Drive, Miami; New Dining Hall Building, Florida State University, Tallahassee, Fla.; and in the offices of the Dade County Board of County Commissioners, Miami.

Missouri River Bridge Expedites Kansas City Traffic

Kansas City's recently opened Broadway Bridge over the Missouri River provides the city a five-minute link between its municipal airport and the downtown business district and affords access to the rapidly developing suburban area to the north. The piers are hollow shafts with solid caps, founded on caissons sunk by open dredging and sealed by pneumatic operations. Joint-venture contractors for the piers were the Guy H. James Construction Co., Oklahoma City, Okla., and Cunningham-Kiewit, of Omaha, Nebr. The triple-span steel trussed-arch structure, part of a $12,000,000 project, was designed by Howard, Needles, Tammen and Bergendoff, Kansas City, Mo., and fabricated and erected by the American Bridge Division of U. S. Steel. The lightweight aggregate concrete deck, topped with an asphaltic concrete wearing surface, is suspended from the arches by groups of four 1⅝-in.-dia wire ropes of high-strength steel (155,000-psi yield point).

Many Projects on Alaska Construction Agenda

A big construction year is in store for Alaska, according to Col. Pierre V. Kieffer, Jr., Alaska district engineer, who has just announced that the Alaska District of the Corps of Engineers will supervise more than $125,000,000 construction projects for the U. S. Army and U. S. Air Force in 1957. A breakdown of this figure, which includes some $86,000,000 in new construction, shows approximately $38,200,000 earmarked for new Air Force projects to be contracted during the first six months of 1957. Some of these installations will supplement facilities at the huge bases such as Elmendorf, near Anchorage, and Ladd and Eielson in the Fairbanks area. More than $47,800,000 in new construction is planned for the U. S. Army. In addition to defense construction, seven new civil works projects worth $7,000,000 will also get under way. An estimated $5,500,000 of this will go for harbor improvement and flood control.

Prospective expenditures are in addition to $827,000,000 that has gone for defense spending in Alaska in the decade since 1946 when the Alaska District was formed.

Contracts Awarded for St. Lawrence Bridge

Another major feature in the St. Lawrence Seaway Project is getting under way following recent award of two contracts for construction of a high-level suspension bridge over the south channel of the St. Lawrence River near Massena, N. Y. The American Bridge Division of U. S. Steel has a $4,759,045 contract for the superstructure, and the McNamara Construction Company, Ltd., of Toronto, a low-bid contract of $1,240,550 for the substructure. To meet a tight construction schedule that calls for having the structure ready for traffic by November 30, 1958, the substructure contractor is assembling plant and equipment to work all winter.

Borings for the project were started by the Corps of Engineers on July 20, 1956, following a decision to abandon plans for a series of four low-level bridges on a circuitous route in favor of one high-level structure. D. B. Steinman, New York consultant, was retained to prepare the design and specifications for both the substructure and superstructure. He will act as consultant to the Corps of Engineers during construction of the project.

Concrete Pipe Revisions Proposed by ASTM

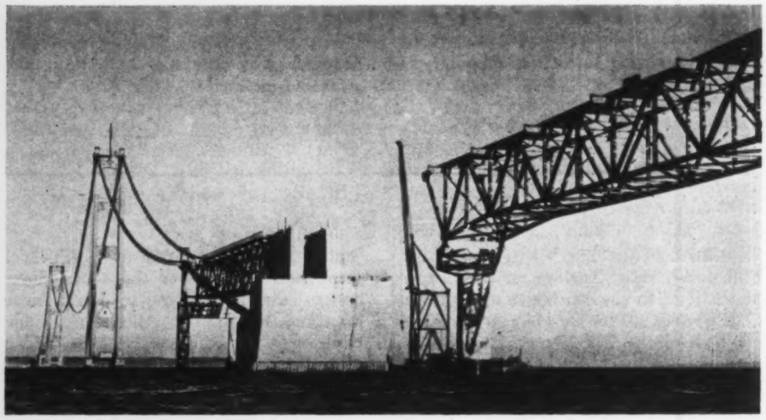
Significant revisions in the design and requirements of concrete pipe were proposed at a meeting of Committee C-13 on Concrete Pipe of the American Society for Testing Materials, held in Chicago recently. Subject to letter ballot, the committee has accepted a proposed complete revision of the specification for reinforced concrete pipe for gravity sewers and culverts, which revises, combines, and enlarges the present requirements of C75 and C76. This means that the recommendation presented to the ASTM will provide for the discontinuance of Specification C75 with the new specification continuing the designation C76.

The new concept in design is known as the "D-Load" method, which is a means of classifying the load on pipe. There are two kinds of D-Loads for the three-edge-bearing test in the revised specifications. "D-Load Ultimate" is the load per linear foot of pipe per foot of diameter to produce ultimate failure. "D-Load .01-in. crack" is the load per linear foot of pipe per foot of diameter to produce the .01-in. crack. The new specification is designed for both types of D-loads, whichever is desired by the consumer. Tables make it possible to choose the pipe especially designed to withstand five different degrees of loadings. The new specification also provides for a choice of pipe design that will fit into the D-load Ultimate tables as currently set forth in the Bureau of Public Road's new design and installation criterion for concrete pipe culverts.

The need for a specification for perforated concrete pipe was discussed with a special subcommittee being authorized to draft a specification for both plain and reinforced perforated concrete pipe. Important changes were accepted for immediate adoption in the Specification for Concrete Sewer Pipe (C14). A basic change provides two tables—one for standard-strength, the other for extra-strength, non-reinforced concrete sewer pipe. A new section was added to provide control requirements on the repair of pipe necessitated by occasional imperfections in manufacture or accidental injury during handling. Changes were made in the section describing the permeability test to provide greater clarity and understanding. The hydrostatic test requirements will be returned to the specification as an optional procedure.

A special Subcommittee on Absorption presented revisions in specifications for reinforced concrete sewer and culvert pipe to provide for use of cores in determining absorption. The revisions which were accepted, subject to committee letter ballot, provide for a smaller area of specimen and will allow specimens for absorption to be either broken from the pipe or cored as specified elsewhere in the requirements.

Winter Halts Work on Mackinac Bridge



With only two of the 28 Mackinac Bridge approach spans remaining to be completed, the American Bridge Division of U.S. Steel was obliged to end amphibious operations in the Straits of Mackinac late in December. Photo shows 180-ft floating derrick finishing clean-up work on the south cable anchorage. One of major accomplishments of 1956 construction season was record speed of spinning operations for the two main suspension cables. The first of the 12,580 wires making up each cable was spun on July 18, and work on both cables was completed on October 19. Three hundred men worked day and night spinning the 41,000 miles of tough steel wire which went into the main support cables. Stretching 8,614 ft between anchorages, these cables form the principal support for the bridge roadway. Unfinished work includes completion of all approach spans and erection of the suspended spans, suspender ropes, and floor system. Only the outer two lanes of the four-lane roadway will be concrete filled; the two inner lanes will be of open steel grating design. When the bridge is opened to traffic in November 1957, it will link Michigan's Upper and Lower Peninsulas.

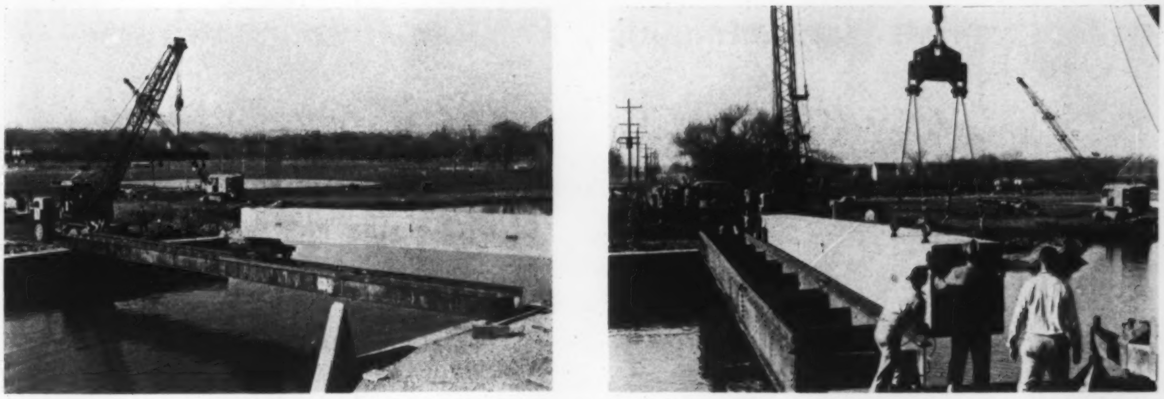
Loan to Nicaragua for Inter-American Highway

A $2,000,000 loan to assist Nicaragua in completing its section of the Inter-American Highway is announced by the Export-Import Bank. The loan will aid Nicaragua in building 107 miles of the Inter-American Highway across that country from Honduras to Costa Rica. Up to now Nicaragua has built 135 miles —from Sebaco 65 miles northeast of Managua to Rivas 70 miles southeast of Managua. The new project calls for completing 85 miles of highway between Sebaco and El Espino on the Honduran border and a 22-mile stretch between Rivas and Penas Blancas on the Costa Rican border.

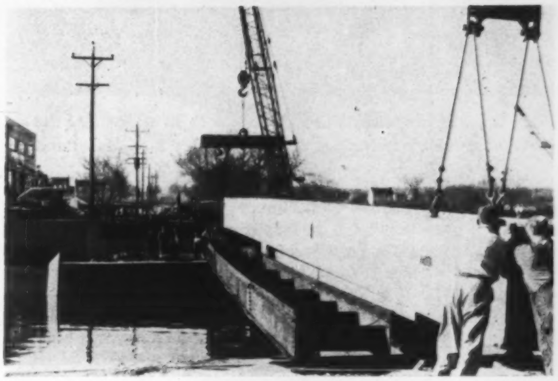
The total cost of completing the Inter-American Highway to Nicaragua is estimated at $8.5 million, of which the United States' share will be $5.7 million. The highway, which is being built in cooperation with the U. S. Bureau of Public Roads, will extend 1,590 miles from the Texas border to Panama City.

Two New Laboratories For Portland Cement

A contract for constructing two new laboratory buildings at the Portland Cement Association's Research and Development Laboratories at Skokie, Ill., has been awarded to the George A. Fuller Co., of Chicago. Scheduled for completion late in 1957, the two modern buildings will provide for the association's expanded research and development program on concrete structures and the fire resistance of concrete. They were designed by Dunlap and Esgar, Inc., Chicago architects, in cooperation with the Portland Cement Association staff. Cost of the two is estimated at about $2,750,000.



At bridge site forward end of beam is placed on four-wheeled dolly (left-hand photo), rolling on temporary I-beams and pushed across the span. In view at right 25-ton mobile crane at each end lifts beam and sets it on abutments.



Here second beam is in position and nearly ready to be lifted into place.

Pretensioned Prestressed Bridge Beams Span 76 Ft

The Pennsylvania Department of Highways recently completed a two-span deck-girder bridge, consisting of pretensioned precast hollow rectangular beams 78 ft long, across Manataway Creek, Borough of Pottstown. Each beam weighed 28 tons, and was 36 in. wide and 42 in. deep, with 4½-in. side and bottom walls, and 5-in. top slab, which formed the roadway. Solid diaphragms were provided at both ends and at the third-points of the beams.

Keyways in the sides of the beams near the top were grouted with stiff mortar after all beams were in place to transfer loads on one beam to adjacent beams. Through holes cored transversely through the diaphragms rods were passed on which nuts were tightened to hold the beams together. The beams were transported to the site on pole trailers. The pictures show the sequence of placing the first beams. As soon as the first three beams were in place the loaded truck was run directly onto them so that the 25-ton mobile cranes at each end could lift the beams directly into final position in the bridge.

The bridge was designed in the Department of Highways, for which R.W. Arner, M. ASCE, is bridge engineer. The beams were manufactured in the Pottstown plant of Concrete Products Co. of America, Division of American-Marietta Co. of Pennsylvania and placed by erection contractor Mayer Pollac Co.

AWWA Establishes New Scholarships

Establishment of a $1,500 educational aid fund is announced by the American Water Works Association and the Sewage Works Manufacturers Association. The fund, which will be known as the Harry E. Jordan Scholarship Award, will be available each year for graduate study in courses in science, engineering or business administration "considered to contribute to the advancement of water supply practice and management." Applicants with high scholastic standing, who would otherwise be unable to complete their professional training, will be given first consideration.

Applications must be submitted before December 1 to the American Water Works Association, which has new offices at 2 Park Avenue, New York 16, N. Y.

Army Offers Commissions to Qualified Engineers

The Army is offering a limited number of Reserve commissions to qualified civil, sanitary, and chemical engineering graduates, according to an announcement from the Surgeon General. During the next two years about fifty engineers will be able to join the Army Medical Service Corps in grades from second lieutenant through captain, with concurrent call to duty. Applications for appointment under the program may be accepted and processed before the student receives his qualifying educational degree, provided they are accompanied by a certificate from the appropriate university official certifying that the candidate will receive the required degree within four months. Company grade Medical Service Corps officers of reserve components not on active duty may also volunteer for service under the program.

Details about the program may be obtained from the following procurement officers: Maj. Edward E. Bird, Headquarters, First Army, Governors Island, New York; Maj. George J. Nardone, Headquarters, Second Army, Fort George C. Meade, Maryland; Maj. W. G. Handorf, Headquarters, Third Army, Fort McPherson, Ga.; Maj. John N. Shipway, Headquarters, Fourth Army, Fort Sam Houston, Tex.; Lt. Col. John Rosenthal, Headquarters, Fifth Army, Chicago 15, Ill.; and Lt. Col. Kenneth W. Seymour, Headquarters, Sixth Army, Presidio of San Francisco, Calif.

Pennsylvania Lays Continuously Reinforced Concrete Highway

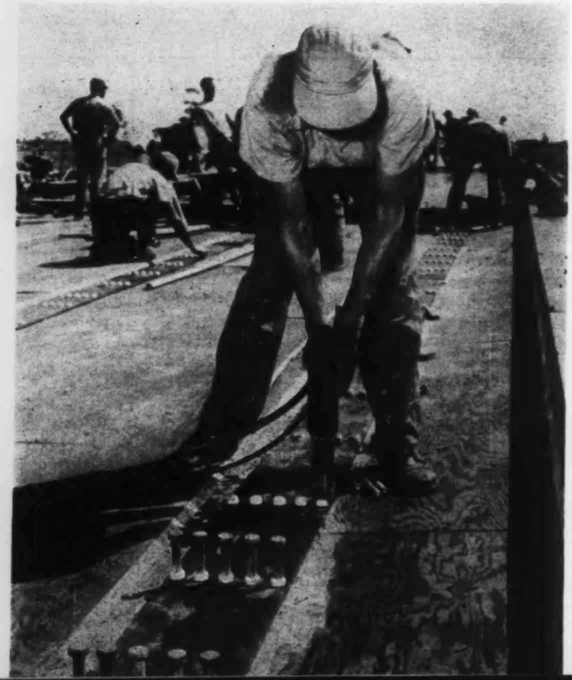
With the 4½ in. base course of concrete in place and leveled by the strike-off machine, a 16-ft by 6-ft 2-in. deformed mat bar is put in place (left-hand photo). Overall shot at the right shows the compactness of the operation.

The Pennsylvania Department of Highways has completed its first section of continuously reinforced concrete highway—a two-mile dual-lane stretch on Route 111 north of York, Pa. Concrete pouring started September 18, and the last pour was made October 19. The cost came to about $5.47 per lin ft.

Special deformed reinforcing mats strengthen the 9-in.-thick stretch, replacing the contraction and expansion joints and standard reinforcing steel normally used in highway construction. The mats, which are 16 ft long and 6 ft 2 in. wide, weigh 185 lb per 100 sq ft. They were laid 4½ in. below the surface—at mid-point of the slab. In placing the mats on top of the first 4½-in. concrete course, they are overlapped a foot at each end and 8 in. along the sides. The bar mats consist of seven ⅝-in.-dia transverse bars and ten ⅝-in.-dia longitudinal bars. Where longitudinal and transverse bars cross, they are bound together by clips. Clips are also used to connect adjacent mats.

In connection with the project, the U. S. Bureau of Public Roads, the Pennsylvania Department of Highways, and the American Iron and Steel Institute have contracted with Lehigh University, Bethlehem, Pa., to test and evaluate the installation. The decision to install the experimental section was made by Pennsylvania Secretary of Highways Joseph J. Lawler and Robert A. Farley, chief engineer in charge of maintenance. The two-mile section was laid by the H. J. Williams Co., York, Pa.

Information on which this item is based and the photos were furnished by the Bethlehem Steel Co.



New Field Welding Technique Speeds Bridge Erection on Florida Turnpike

Use of headed shear connectors installed in the field with a stud-welding gun has enabled the contractors working on an eight-mile section of the Florida Turnpike, near Stuart, to reduce substantially the time normally required for erection of composite bridge decks. This field technique, in which Nelson shear connector studs, ¾ by 4 in., are installed with a NS-9 gun, powered by twin 600-amp gasoline-driven Hobart welders, is being demonstrated at the Chicago Road Show. On the stud-welded decks for five bridges erected by the Montgomery Construction Co. for the project, a welder and his helper installed all the studs for one full 50-ft span in about two hours. Carpenters first erected forms for the deck over one span, providing a working surface for the stud welders, who were closely followed by a reinforcing group. When they moved on to the next span, the concreting began. This procedure made it possible to complete an entire 50-ft span in one day.

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"Joe Kerr sent you a message before he left, Professor."

"Left?"

"Right!" said Cal Klater. "He's driving thru to the Jackson Meeting, and had to leave early. Here's his note."

"Well, well, a new problem. Hmm-mmm, says he worked it. Looks good. Also he had trouble with my problem of 6 men in a block. Heh, heh! He guesses Case and Dunn live in a duplex. Did I fool you too, Cal?"

"Not very long. You said there were 5 houses between Ames and Barr, that Case lived in the middle one, that there were 2 houses between Barr and Dunn and 3 between Ames and East, that Farr was as far from Dunn as from Ames, that Barr lived in the 5th house east of East, and that you wanted to know who lived farthest from whom."

"That's the picture."

"But out of focus until I focussed on Barr and East. Measuring from Ames, Barr is in the 6th house and Ames in the 4th house, making one house between them if measured in the same direction and 9 houses between them if measured in opposite directions. But later you locate Barr in the 5th house east of East, leaving only 4 houses between them. So the 'Block' isn't a row of houses between intersecting streets but a closed circuit of houses surrounded by streets. In fact, there must be 15 houses in some such pattern as Fig. 1. Only Case and East are separated by as many as 6 houses."

"Let's drop a card to Joe at Jackson and tell him there weren't any duplexes and the block was splenoid. Now let's look at his idea of a good problem. He has a drawing (Fig. 2) under which he wrote:

"'This is a network of 12 resistance wires shaped like the edges of a rectangular prism. If included in an energized circuit by connections at vertices A and B, potentials at the other 6 vertices can be exactly the integers 5, 6, 7, 8, 9 and 10. I used this scheme to get these voltages for an electric analog of a ground-water problem, getting also voltages of 1, 2, 3 and 4 by attaching one lead to the 5-v vertex instead of to the ground. What should be the voltage at A?'

"I guess that's a challenge, Cal. Can we do it?"

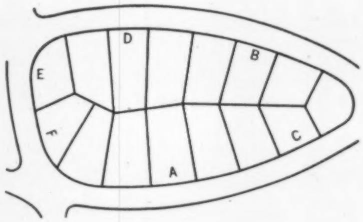


Fig. 1. Only Case and East are separated by six or more neighbors.

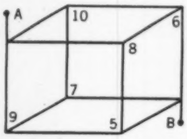
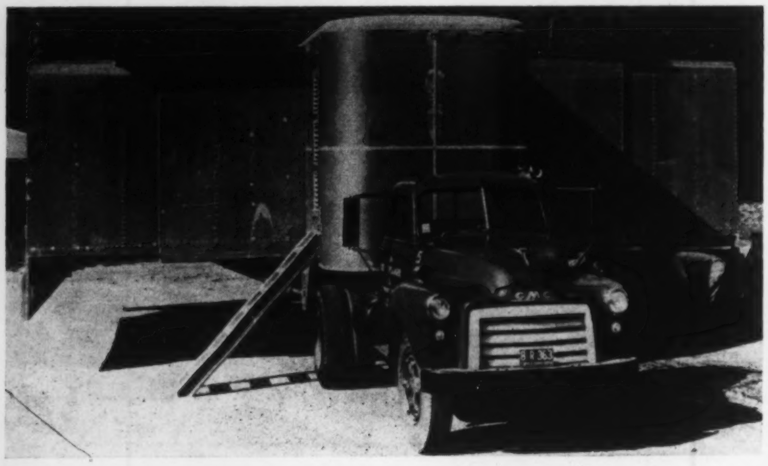


Fig. 2. Joe Kerr's digital network for analog potential.

[Cal Klaters were Ab Stract (Manuel A Benson) Ed C. Holt Jr, Slip Sticker (Wayne Heasley), Thatchrite (Guy C. Thatcher), Walter J. Tudor, and Carl B. Oustad. Favorite block was not splenoid, but circular with a central pond to keep neighbors from short-cutting.]

Trailer Truck Expands to Five Times Its Normal Size



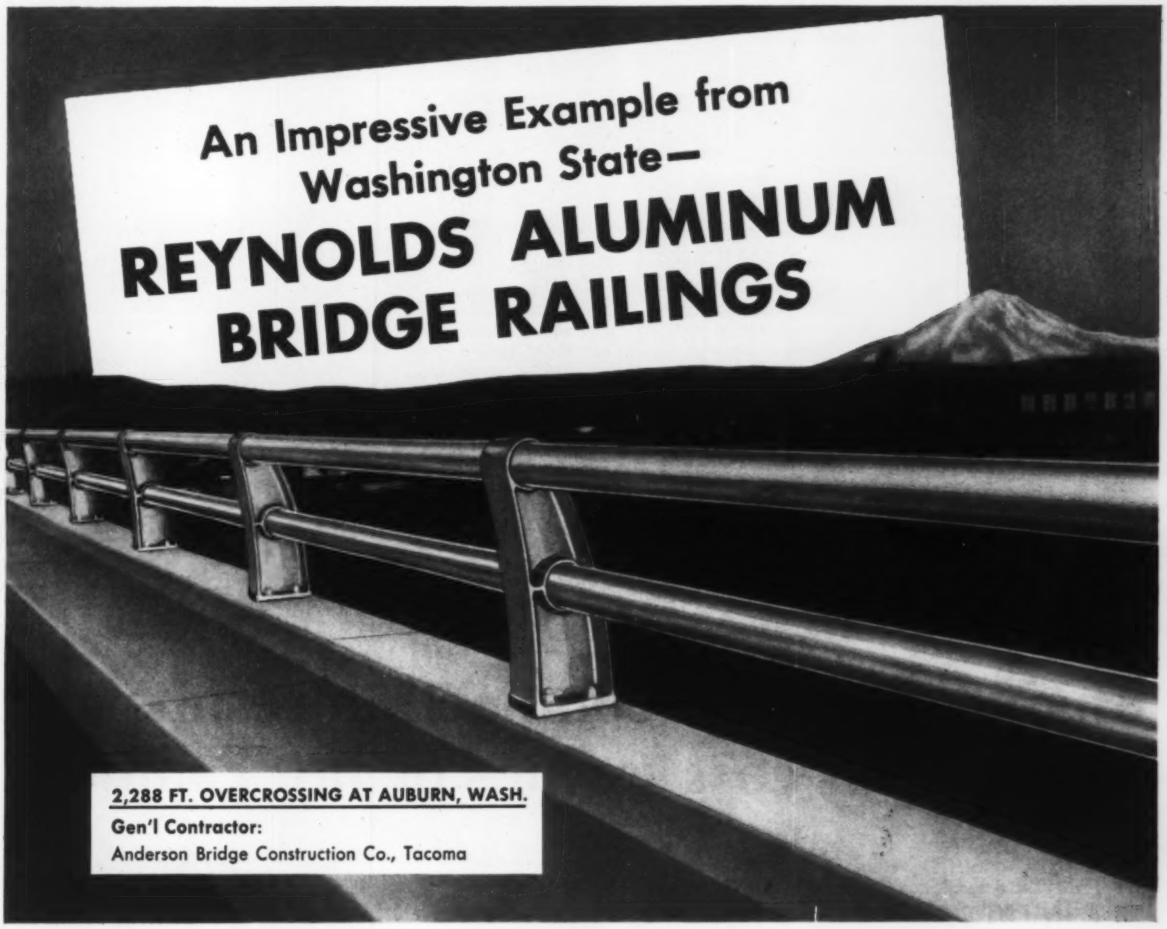
By push-button control this 14-ton trailer truck of Alcoa aluminum can be expanded to more than five times its on-the-road dimensions—or from 150 to 780 sq ft, inside area—making it a boon to the mobile-home industry. Electrically operated hydraulic and chain-drive mechanisms provide power for telescoping the sides outward and dropping accordian-folded aluminum floors into place. On the road the trailer measures 35 ft long and just under 8 ft wide. Fully expanded the interior dimensions are 30 ft long, 26 ft wide, and 7½ ft high. When the trailer is opened out, each side holds fifty men without "listing." It can be drawn by any standard truck power source. The Gerstenslager Company, of Wooster, Ohio, is the manufacturer.

Canada Installs More Hydroelectric Plants

To meet increasing demands for electric power, Canada stepped up its construction of hydroelectric plants in 1956. In addition to the 845,000 hp of new capacity installed during the year, construction progressed on a number of other projects that will bring over 1,500,000 hp into operation in 1957 and, in all probability, more than 2,500,000 hp in 1958. The province of Quebec continues to maintain its lead in water-power installation, and the greatest single addition to new capacity in 1956 was a 450,000 hp installation at the Bersimis No. 1 development of the Quebec Hydroelectric Commission.

With the 1956 additions, the total installed capacity of Canadian waterpower plants is now listed at 18,356,148 hp—less than 28 percent of total resources. A number of new high-capacity sites are being investigated with a view to early development.

Free copies of Bulletin No. 2551, reviewing hydroelectric progress in 1956, may be obtained from the Director, Water Resources Branch, Department of Northern Affairs and National Resources, Ottawa, Canada.



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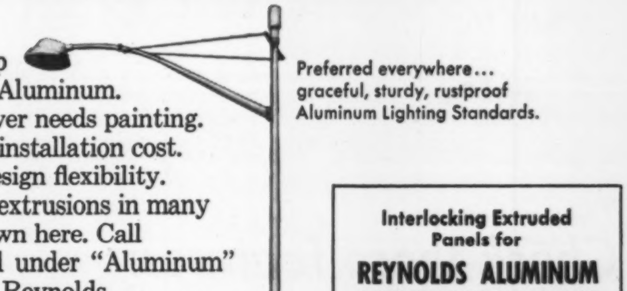

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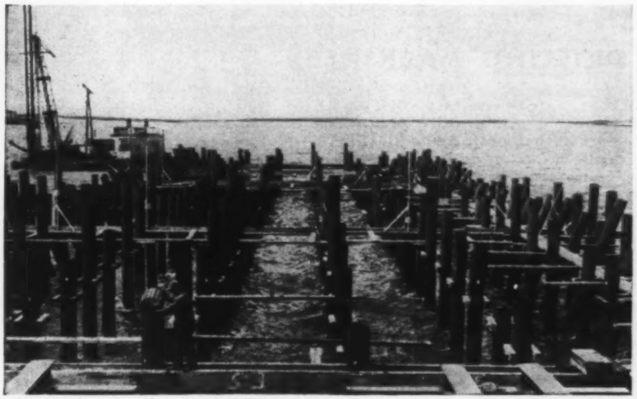

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GAGE—3
NUMBER OF PILES—1638
LENGTH—50 TO 110 FEET
LOADING—50 TONS
DISTANCE FROM MUD LINE TO PILE CUT-OFF } APPROX. 30 FEET

DESIGN: BUREAU OF YARDS & DOCKS, U. S. NAVY
CONTRACTOR: RAYMOND CONCRETE PILE COMPANY

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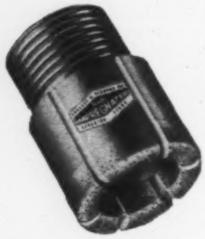

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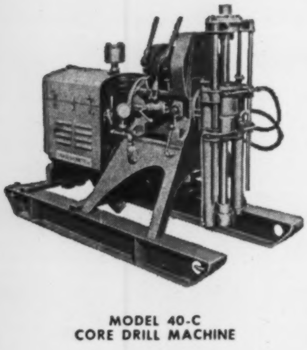

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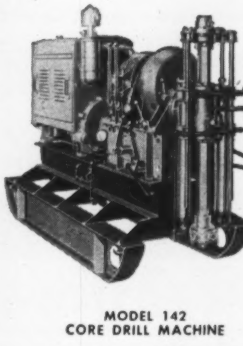

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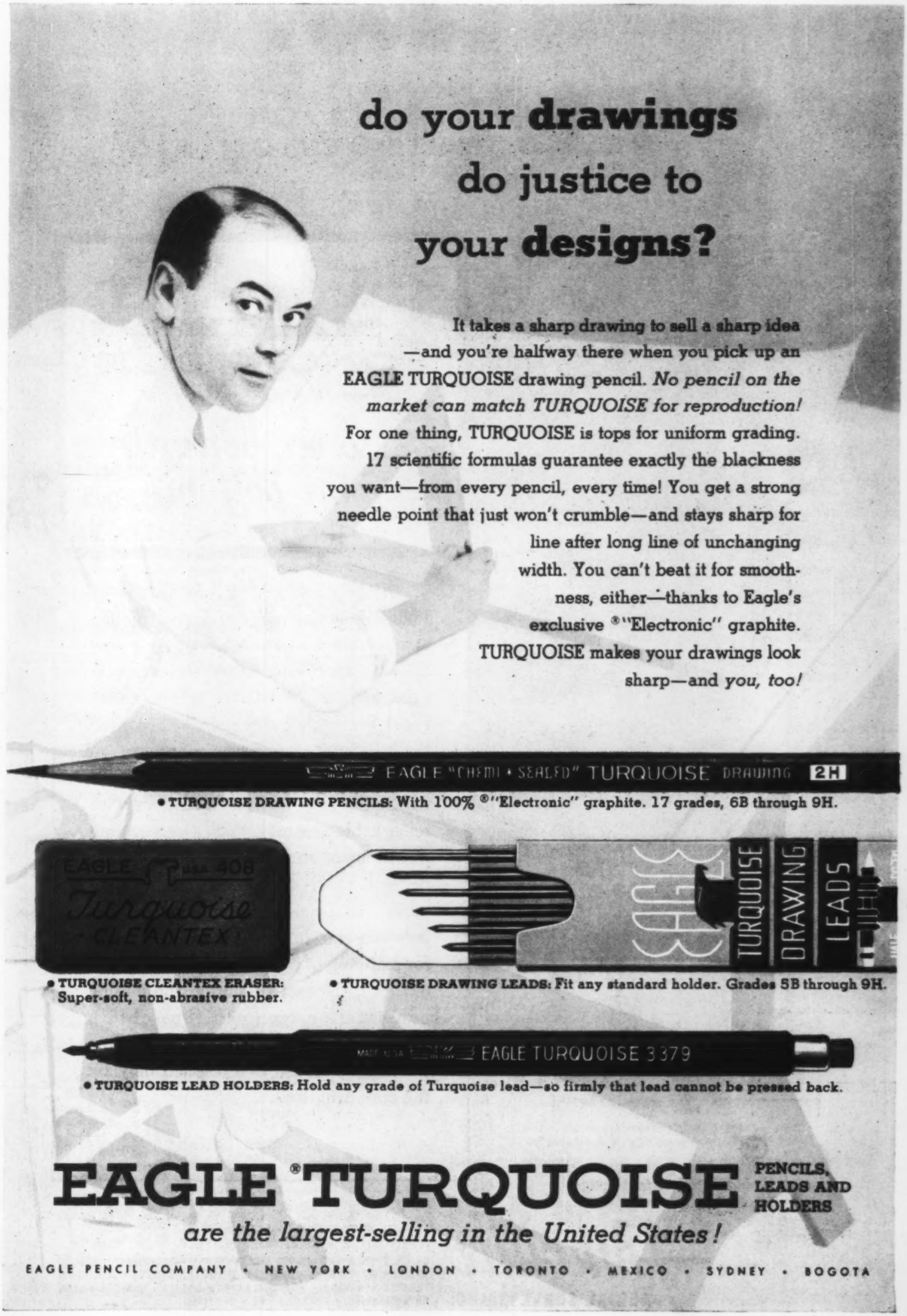
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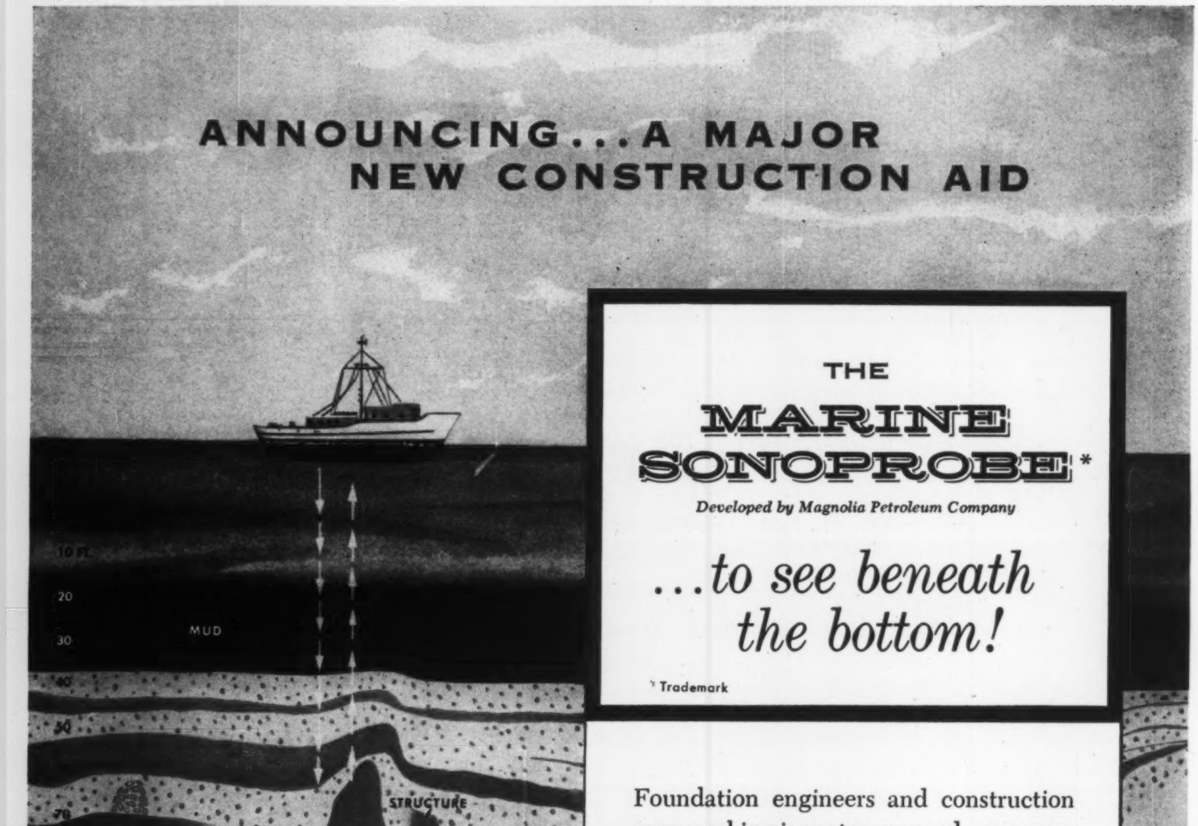

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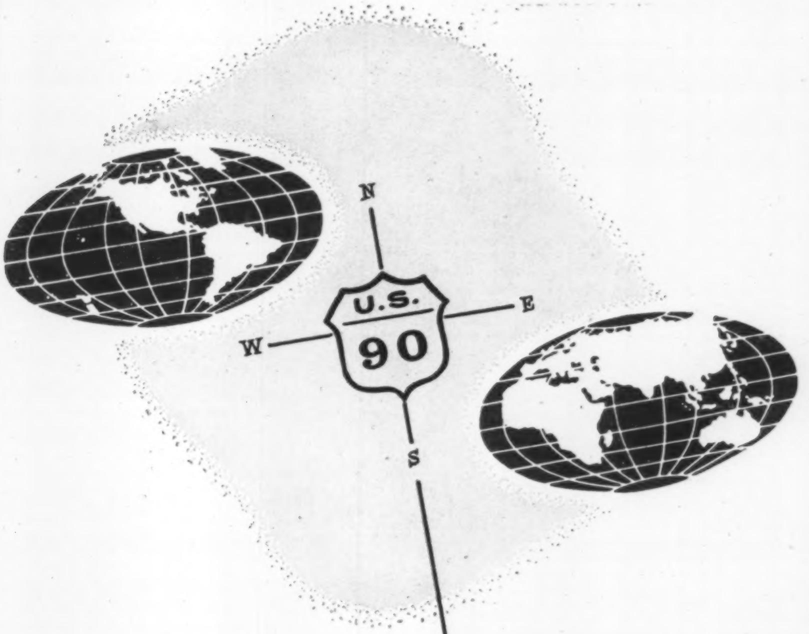

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Vol. III. Fluidity

The first volume of this treatise by Keith Swainger formulated the theory of the analysis of deformation; the second volume dealt with applications and available experimental evidence. The present volume presents the author's analysis of the fluidity aspects of deformation and a critical examination of the classical approach to fluid mechanics. The main topics considered are viscous plane flow; three-dimensional viscous flow; stress-fluidity; and the influence of boundary conditions on flow. (The Macmillan Company, 60 Fifth Avenue, New York 11, N.Y., 1956. 266pp., bound. $13.00.)

ASTM Standards in Building Codes

Supplement to 1955 Edition

Together with the 1955 compilation, this supplement provides a convenient source for ASTM standards on the full range of construction materials, including structural and reinforcing steel; copper, cast iron, and steel pipe; building units; bituminous roofing; cement; gypsum; and ready-mixed concrete. The supplement includes seven new specifications, two new methods of test, descriptions of the revisions of 63 standards, and 21 extensively revised standards in full. (Published 1956 by the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., 1956. 214pp., paper. $2.75.)

The Economics of Soviet Steel

M. Gardner Clark is author of a four-part study of the development of the Russian iron and steel industry from 1917 to the present. Based almost entirely on Soviet sources, the volume is concerned with the growth of production and investment; the specialization and size of plants and equipment; factors affecting plant location; and productivity. A considerable amount of statistical data is provided in appendixes, and a bibliography is included. (Harvard University Press, Cambridge 38, Mass., 1956. 400pp., bound. $7.50.)

Einflussflachen für Kreuzwerke

Structural analysis of grillages with varying numbers of longitudinal members and cross beams. Extensive tables and diagrammatic representations illustrate the theoretical aspects and aid in practical design. The information is applicable to steel, reinforced concrete, prestressed concrete, and wooden beams and girders for buildings and bridges. (By H. Homberg and J. Weinmeister. Second Edition. Springer-Verlag, Berlin, Germany, 1956. 156pp., bound. DM 43.50.)

Engineering Mathematics

This text for the first year of graduate work in engineering deals with the following topics: determinants and matrices; special subjects in integration such as the Gamma function, the error function, and Euler's constant; linear differential equations; Fourier series and integrals; the La Place transform; network theory; and probability, with emphasis on functions of random variables. Appendixes deal at a somewhat higher mathematical level with Borel sets, the Riemann-Stieltjes integral, and Fourier series and integrals. (By Kenneth S. Miller. Rinehart and Company, Inc., 232 Madison Avenue, New York 16, N.Y., 1956. 417pp., 6 x 9¼ in., bound. $6.50.)

Handbook of Standard Structural Details for Buildings

This is an illustrated guide to the preparation of working drawings for six types of buildings: a small house, a small masonry building, a reinforced concrete building, a steel frame building, an industrial building, and a timber building. Scale drawings of details of design are accompanied by descriptions explaining the reasons for including the details given and suggesting alternative methods of presentation. (By Milo S. Ketchum. Prentice-Hall, Inc., Englewood Cliffs, N.J., 1956. 120pp., 7 x 10¼ in., bound. $4.65.)

Konstruktive Grundzüge und Praktische Erfahrungen Beim Bau und Betrieb von Stahlwasserbauten

Design principles and practical information on the construction and operation of steel hydraulic structures, with particular attention to weir gates and lock gates, are given in this volume by F. Kohler. Mechanical details are shown for various types of such machinery, with illustrations of equipment of German manufacture. (Springer-Verlag, Berlin, Germany, 135pp., paper. DM 13.20.)

Momentum Transfer in Fluids

This book aims to give sufficient background in laminar and turbulent shear-flow, boundary-layer analysis, and the statistical treatment of turbulence to give the reader an understanding of the nature of local fluid motions frequently encountered in industry. Considerable stress has

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been placed on the behavior of laminar boundary layers and the transition from these boundary flows to the main boundry of a turbulently flowing stream. A full chapter has been devoted to the basic equations of the motion of fluids, and laminar and turbulent boundary flow for a compressible fluid have been discussed briefly. (By W. H. Corcoran, J. B. Opfell and B. H. Sage. Academic Press Inc., Publishers, 111 Fifth Avenue, New York 3, N.Y., 1956. 394pp., bound. $9.00.)

Sewage Treatment

This standard text by K. Imhoff and G. M. Fair provides the sanitary engineer with the essential practical information needed for the design and operation of sewage treatment plants. Such general considerations as costs, plant location, and works equipment are briefly discussed, and the various methods of treatment common in American cities and industries are dealt with fully. New processes covered in this edition include step aeration in the activated sludge process and continuous loading and unloading of sludge digesters with thickened sludge. (Second edition, 1956, John Wiley and Sons, 440 Fourth Avenue, New York 16, N.Y., 1956. 338pp., bound. $7.50.)

Stahlbau (Vol. I)

A handbook on structural analysis and design that covers both theory and practice. Beginning with introductory chapters on the mathematics and materials involved, the author then devotes the major part of the work to a detailed treatment of the statics of structures including space frames and indeterminate structures. The book closes with chapters on stability investigations and vibration theory. (Sponsored by Deutscher Stahlbau-Verband. Stahlbau-Verlags, Cologne, Germany, 1956. 317pp., bound. DM 28.50.)

Die Theorie der Drillfestigkeit von Stahlbauteilen

A presentation of the theory of torsional resistance of structural steel members, with examples of application to both straight and curved beams of various cross section. Examples of stress analysis are given, and some standard sections are considered as well as theoretical shapes. [By F. Wansleben. (Forschungshefte auf dem Gebiete des Stahlbautes, No. 11) Stahlbau-Verlag, Cologne, Germany, 1956. 52pp., paper. DM 13.50.]

Trigonometry Refresher for Technical Men

This volume is a twin to the "Calculus Refresher for Technical Men," by the same author, A. A. Klaf. It is a very clear and practical presentation, using the question-and-answer method. The reader can test his ability and rate his improvement against 1,738 problems, with their answers. Included are angular relations, functions, plane triangles, logarithms, slide rule, vectors, surveying, navigation, complex numbers, series, spherical triangles. (Dover Publications, Inc., 920 Broadway, New York, N. Y. 629 pp., $1.95.)

Tunnelbau

Modern methods of tunnel construction are described for both the practicing engineer and the student. The major part of the book by Carl Aussendorf, is devoted to the simpler types of tunnels and tunnel construction, with separate sections on subaqueous work, subway construction, and tunnel breaks and repairs. There is a brief chapter on the history of tunneling operations. (Verlag Technik, Berlin, 1956. 312pp., bound. DM 33.00.)

Wasserstrassen und Hafen, Volume I.

Binnenwasserstrassen und Binnenhafen.

A highly practical summary of modern experience in the planning, design, construction, and operation of inland water ways and river ports. The book is fully illustrated by sketches, plans, and photographs of actual installations in Germany and contains a bibliography of over 400 references. (By Heinrich Press. Wilhelm Ernst & Sohn, Berlin, Germany, 1956. 500pp., bound. DM 58.50.)

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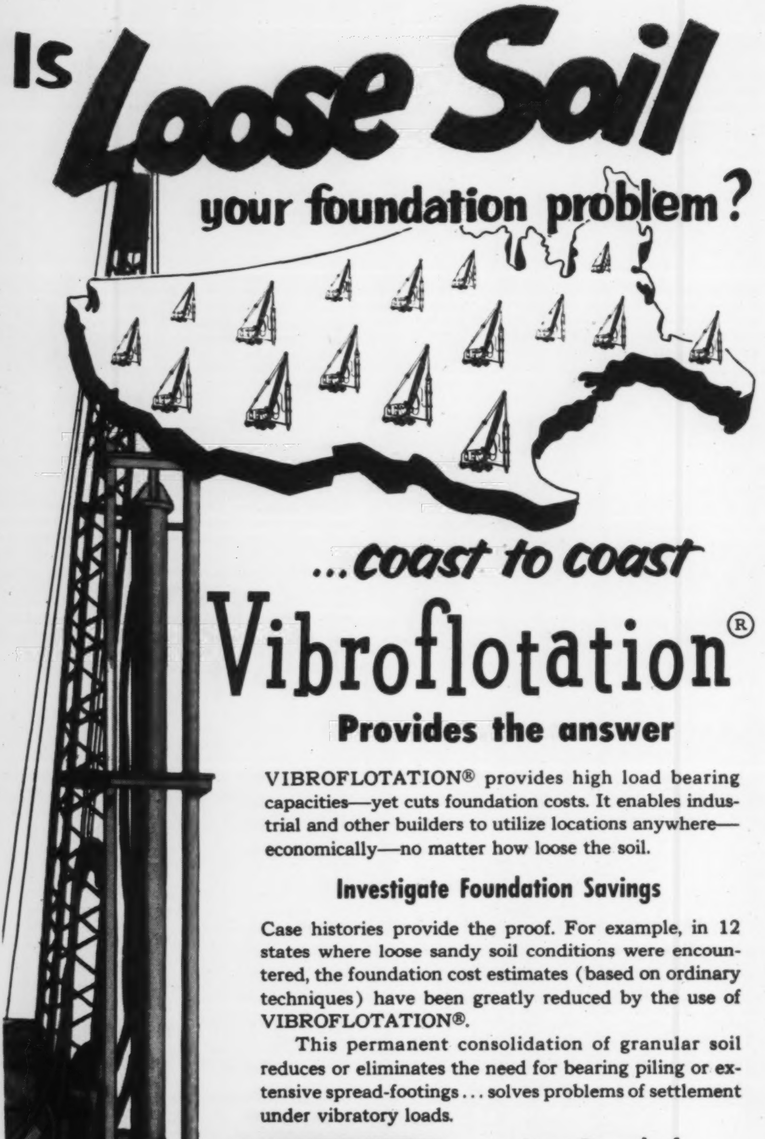

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DECEASED

Howard Merrill Gifft (M. '47), age 48, professor of civil engineering at Cornell University and dean-elect of the university faculty, died unexpectedly at his home in Ithaca, N. Y., December 20. A graduate of Iowa State College in 1932, Mr. Gifft's early engineering experience was with the Iowa State Highway Commission and U. S. Forest Service and on conservation projects in the State of Iowa. After teaching a year at Iowa State College, where he received his graduate and professional degrees in 1941, he was appointed to the Cornell faculty. He served as head of the sanitary engineering department for the past ten years. Professor Gifft was a registered professional engineer and a partner in the Ithaca consulting firm of Bogema, Gifft & Jenkins. He worked on the redesign of the Ithaca Filtration Plant, the Penn Yan Water Storage Reservoir, and sewage treatment plants for Rainbow City in the Canal Zone and Interlaken and Cayuga Heights, N. Y.

Charles Arthur Haskins (M. '21), age 69, head of the consulting firm of Haskins, Riddle & Sharp, Kansas City, Mo., died recently in a hospital in that city. Mr. Haskins graduated from the University of Kansas in 1910 and obtained a master's degree in science from Harvard University in 1914. He had been assistant and chief engineer of the Kansas State Board of Health; professor of sanitary engineering at Kansas University; and chief engineer and architect for the Missouri State Building Commission. He formed the firm of Haskins, Riddle & Sharp in 1953. Designer of many treatment plants and sewerage systems in the Midwest, he was holder of the Arthur Sidney Bedell Award of the Federation of Sewage and Industrial Wastes Associations for "outstanding personal service in the field." He was the author of many papers in the sanitary engineering field.

C. A. Haskins

Adelbert Andrew Henderson (M. '24), age 83, Allegheny County viewer, Pittsburgh, Pa., died recently. A graduate of Ohio Wesleyan University and Ohio State University, Mr. Henderson was in the U. S. District Engineer Office at Pittsburgh from 1900 to 1923. From 1924 to 1932 he was construction engineer for the Allegheny County Department of Public Works, and from 1933 on with the Allegheny County Board of Viewers.

(Continued on page 104)

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Deceased

(Continued from page 102)

Paul Loveridge Heslop (M. '28), age 65, consulting engineer for Kaiser Engineers at Portland, Ore., died at Oakland, Calif., on November 7. Before going to Portland he was with the Corps of Engineers at Bonneville Dam. Prior to that he had spent fourteen years with the Brazilian Electric Company in Rio de Janeiro. As assistant hydraulic engineer for the Electric Bond and Share Company, New York City, earlier in his career, Mr. Heslop was in charge of various hydraulic projects here and in Brazil. He was a 1914 graduate of Cornell University.

Clifford Milton Leonard (M. '10), age 77, engineer and constructor of Chicago, Ill., died recently. Mr. Leonard had been connected with the Leonard Construction Company since 1905—for many years as president and chairman of the board. He was a graduate of the Massachusetts Institute of Technology.

Clarence Crosiar Miner (M. '47), age 59, former civil engineer for the Bureau of Reclamation at Boulder City, Nev., died recently. Mr. Miner had been with the Bureau of Reclamation since 1944. Earlier (1932 to 1944) he was in charge of geodetic and cadastral surveying for the Tennessee Valley Authority at Chattanooga, and prior to that had been with the Tennessee Electric Power Company at Chattanooga. He was a 1922 graduate of Georgia Institute of Technology.

Erling Antonius Normann (M. '47), age 56, project engineer for the Chicago Engineering Board of Review died in that city on November 20. A native of Norway, Mr. Normann graduated from the Norwegian Institute of Technology in 1924 and received his master's degree in civil engineering from the University of Illinois in 1940. Before taking his position with the Engineering Board of Review in 1944, he was structural squad leader for the Department of Subways and Superhighways. He had also been structural designer for the Sanitary District of Chicago. Long active in the Illinois Section, Mr. Normann was a regular attendant at Section meetings and luncheons.

Richard Hamilton Rector (J.M. '50), age 28, civil engineer with Brown & Root, Corpus Christi, Tex., died on November 17. Following his graduation from Georgia Institute of Technology in 1950, Mr. Rector served as a second lieutenant in the Army Corps of Engineers. He had worked on construction projects for the Houston firm of Farnsworth & Chambers, and for the past few years had been with Brown and Root.

(Continued on page 106)

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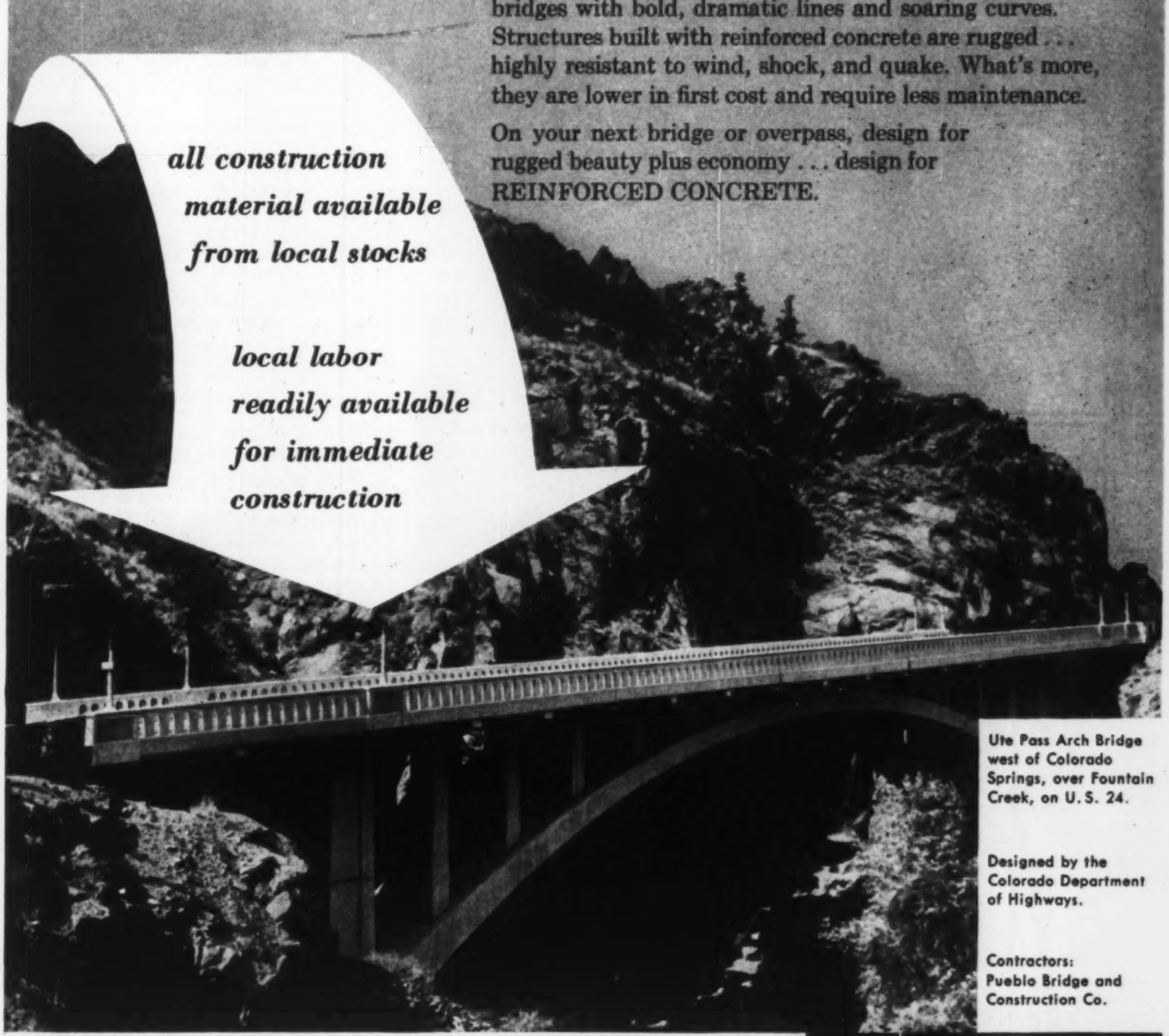
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Other new Mars products include: the Mars-Pocket-Technico for field use, the Mars "Draftsman's" Pencil Sharpener with the adjustable point-length feature, and the efficient, clean Mars lead sharpener. All available — along with the established standards: Mars-Lumograph black graphite drafting pencils, Mars-Technico lead holder and leads, and Tradition-Aquarell painting pencils — at all leading engineering and drafting supply dealers.

J.S. STAEDTLER, INC. HACKENSACK, NEW JERSEY

Deceased

(*Continued from page 104*)

Edward Ephraim Smith (M. '47), age 65, director of utilities for Lima, Ohio, died there recently. Mr. Smith went to Lima in 1918 as superintendent of water filtration, and later was put in charge of sewage treatment facilities. As utilities director since July 1953, he had been chief of eight city water, sewage treatment, and garbage and refuse divisions. Early in his career Mr. Smith was with the U. S. Public Health Service and the Wisconsin Hygiene Laboratory. He was both a civil and chemical engineer, having specialized in bacteriological and biological engineering at Massachusetts Institute of Technology, from which he graduated in 1913. He did postgraduate work at the University of Wisconsin.

John Wesley Stang (A.M. '51), age 56, president of the John W. Stang Corporation, of Los Angeles, Tacoma, Omaha, and New York City, died on December 1. He lived at Downey, Calif. Entering the construction equipment industry as a youth, Mr. Stang was highly successful in pioneering and selling heavy-duty construction equipment to the trade. In 1940 he established the corporation bearing his name, which specializes in wellpointing and other phases of hydraulic and dewatering engineering services. The firm is one of the largest of its kind in the nation.

C. H. Tompkins

Charles Hook Tompkins (M. '18), age 73, civil engineer and builder responsible for many of the major structures in Washington, D. C., and throughout the nation, died in a hospital in the capital, on December 12. In 1911 Mr. Tompkins was co-founder with his wife of the Charles H. Tompkins Construction Co., which was responsible for such capital landmarks as the executive offices of the White House and the Lincoln Memorial Reflecting Pool and for many of the installations at nearby Fort Belvoir and the White Oak Naval Ordnance Laboratory. His firm was one of the builders of such projects as Bull Shoals Dam in Arkansas and Palisades Dam on the Snake River and is currently constructing the $32,000,000 Derbeni-Khan Dam in northern Iraq. Mr. Tompkins' benefactions included donating the Tompkins Hall of Engineering to George Washington University, which awarded him the honorary engineering doctorate in 1946. He had studied at George Washington and at Lehigh universities. Mr. Tompkins was well known in Washington official life, and President Eisenhower was among the notables at his funeral.

NEW MAPS FOR ALL OF CUBA!

Aero Service Begins 45,000 Sq. Mi. Survey

Aero crews are now surveying all of Cuba in one of the largest topographic mapping projects ever undertaken by an aerial mapping company.

Cuba needs new maps quickly, to aid accelerating development of oil and mineral resources, and for other essential planning. The Aero survey will be completed in two years—as opposed to an estimated 40 years required for ground surveys. The $1,100,000 Aero contract represents a fraction of the estimated cost of ground methods.

Controlled Air Photos

Foundation of the maps will be air photos taken from specially modified Aero P-38 aircraft at 30,000 ft. Ground control is based on data from the Inter-American Geodetic Survey and the *Institute Cubano de Cartografia e Cadastro*, plus other data, if needed, from Aero field surveys.

Precise Topographic Maps

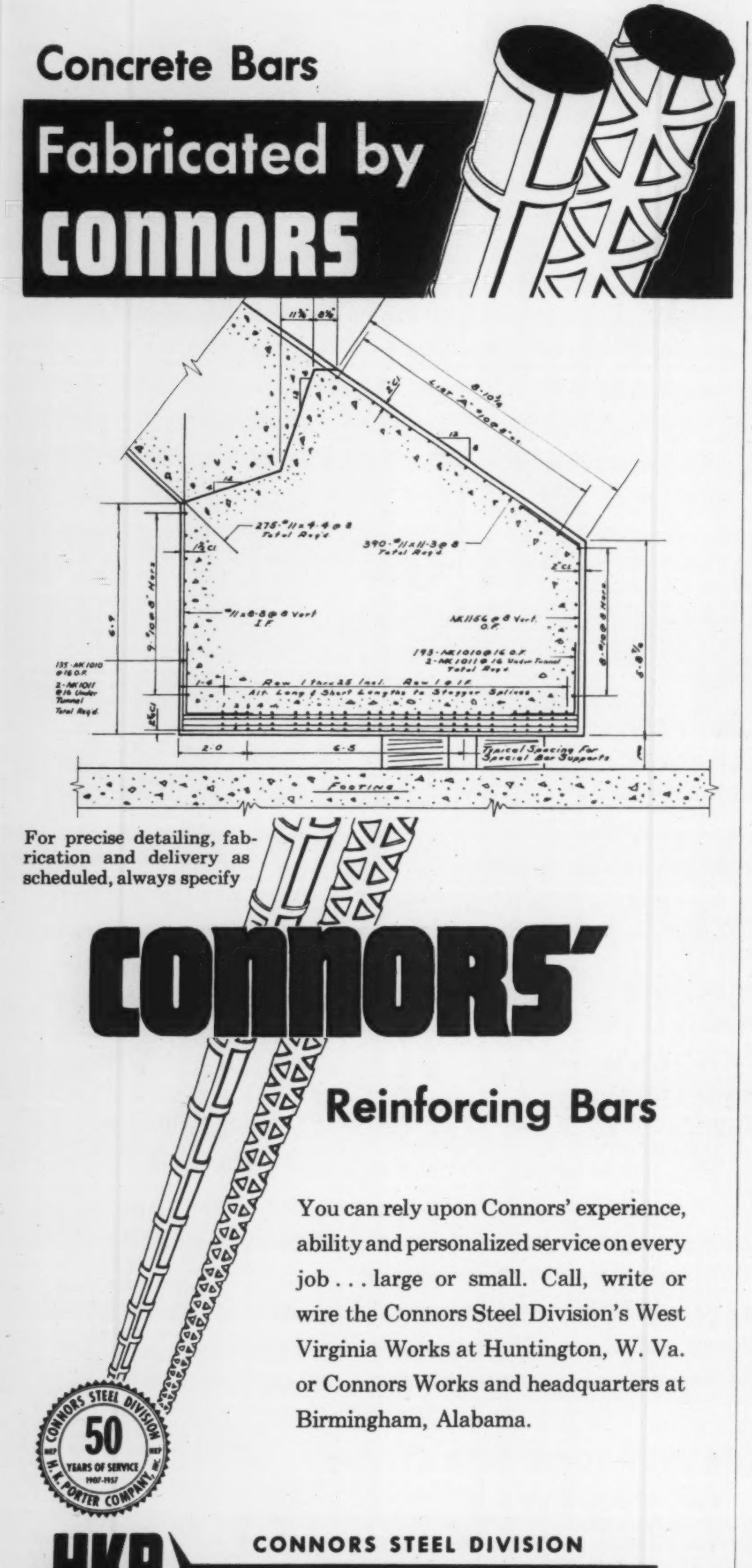
From the air photos, skilled Aero map makers, using precise stereoplotting instruments, will compile 324 map sheets, each 20″ x 15″, at a 1:50,000 scale, with 10-meter contour intervals. 5,500 copies of each map—a total of 1,663,000 six-color maps—will be delivered toward the end of 1958!

Experienced Manpower

The Cuban government, first in the western hemisphere to undertake nationwide mapping at this scale, selected the manpower and 3-million mile experience of Aero, pioneer and leader in aerial surveys. When you need maps anywhere, for any purpose, it will pay you to make Aero your choice also.

AERO SERVICE CORPORATION
Philadelphia 20, Pa.
Oldest Flying Corporation in the World

AIRBORNE MAGNETOMETER SURVEYS • SCINTILLATION COUNTER SURVEYS • PRECISE AERIAL MOSAICS • GEOPHYSICAL INTERPRETATION • TOPOGRAPHIC MAPS • PLANIMETRIC MAPS • RELIEF MODELS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Typical Spacing For Special Bar Supports

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CONNORS STEEL DIVISION 50 YEARS OF SERVICE 1907-1957 H. K. PORTER COMPANY, INC.

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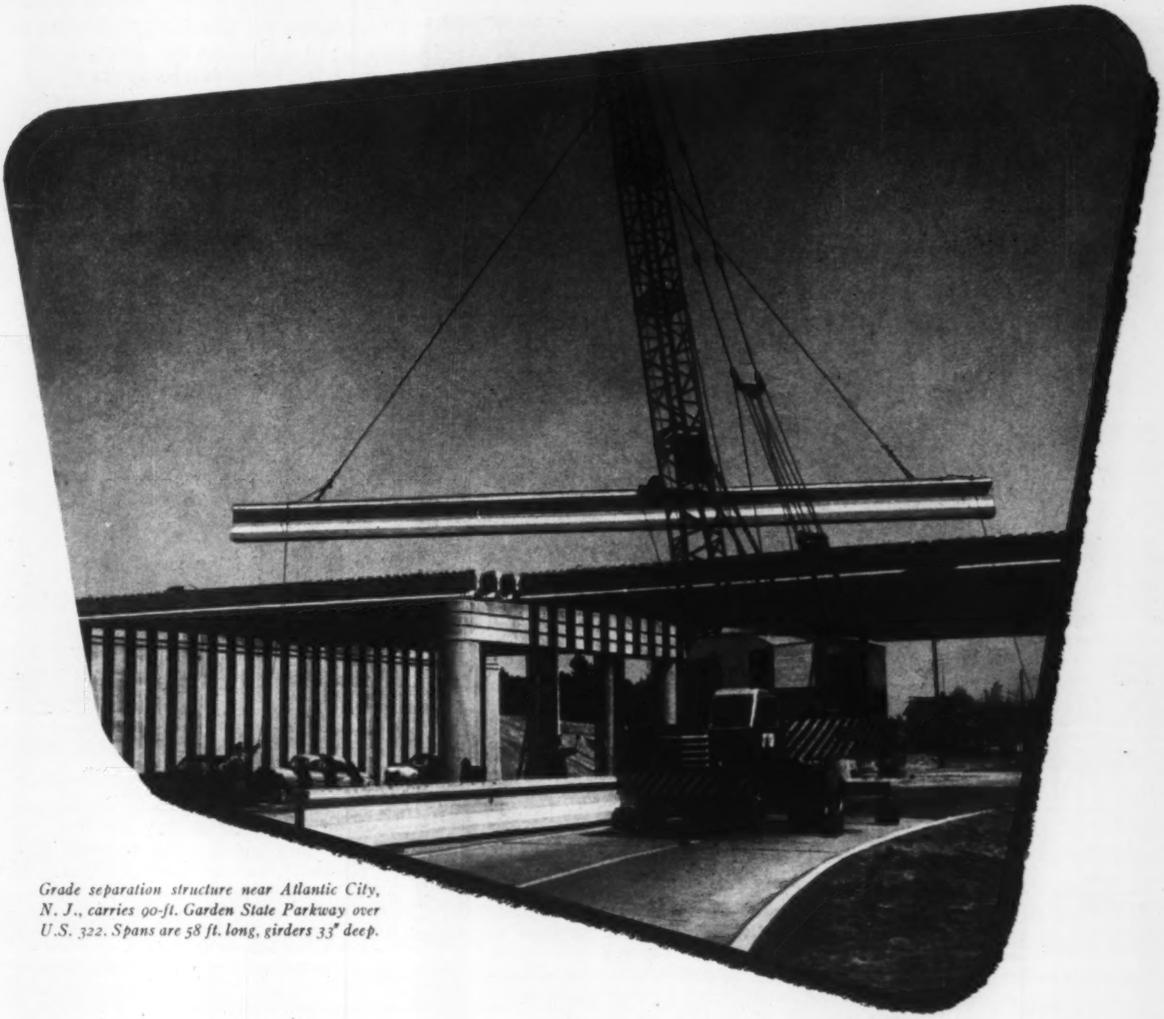
New Publications

Water law . . . An up-to-the-minute review of the California Law of Water Rights—recently published by the Documents Section of the California State Printing Division—is of great value to persons interested in water litigation anywhere in the United States. Wells Hutchins is author of the 572-page volume, which was prepared as part of a revision of "Selected Problems in the Law of Water Rights in the West" (issued in 1942 as Miscellaneous Publication 418 of the U. S. Department of Agriculture). Copies, priced at $10.40 each postpaid, are available from the State Printing Division, 7th and Richards Boulevard, Sacramento, Calif.

Athletic facilities . . . Availability of a set of basic standards for the construction and planning of new athletic facilities is announced by the Athletic Institute. For use by public officials and technical specialists, the 160-page book includes latest suggestions for the functional development of all types of sports areas, playgrounds, parks, stadiums, gymnasiums, swimming pools, and athletic fields, in addition to hundreds of useful ideas for solving construction problems. The volume, which is entitled "Planning Facilities for Health, Physical Education and Recreation," may be purchased from the Athletic Institute, 209 South State Street, Chicago 4, Ill. The price is $2.50.

Scientific and engineering personnel . . . An outline derived from conferences and meetings devoted to "Supervision of Scientific and Engineering Personnel" has been issued by the sponsoring group, the Industrial Relations Section of the California Institute of Technology. The comprehensive text—identified as Bulletin No. 26—was compiled by John T. Lloyd and Robert D. Gray. There is a sliding scale of prices, ranging from $8.75 for one copy plus the Conference Leader's Guide to $3.50 for 1,000 copies plus 25 copies of the Conference Leader's Guide. Orders for single copies should be sent directly to the Bookstore, California Institute of Technology, Pasadena, Calif., and quantity orders to the Industrial Relations Section of the Institute.

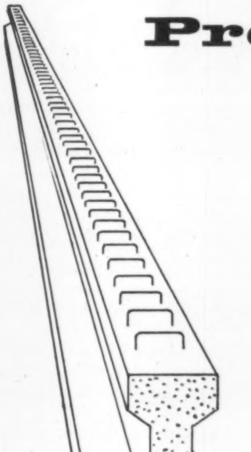
Cement research . . . Articles from the Journal of the American Concrete Institute have been reprinted by the Portland Cement Association in Bulletins D6 and D7. The former—written by Eivind Hognestad, N. W. Hanson, and Douglas McHenry—presents test data that demonstrate the validity of the fundamental plasticity concepts involved in ultimate strength design theories for reinforced concrete, now incorporated into the ACI 318-56, as an alternate design method. Bulletin D7—by J. R. Jenney, Eivind Hognestad, and Douglas McHenry—presents test data and analytical studies



Grade separation structure near Atlantic City, N. J., carries 90-ft. Garden State Parkway over U.S. 322. Spans are 58 ft. long, girders 33" deep.

Extra bridges from your highway budget with

Prestressed Concrete



Thousands of bridges, grade separations and trestles must be built on the National System of Interstate and Defense Highways. Engineers should know how to get extra bridges from their highway budgets.

One way to make substantial savings is to use a basic design for most bridges. Production line techniques then can be employed to lower unit costs of fabricating precast, prestressed concrete members. Using a standard design will also save designers' valuable time, freeing them for work on other projects.

Prestressed, precast concrete eliminates the need for expensive falsework. Since members are smaller, dead weight is reduced. This simplifies transportation, speeds erection. Having unusual durability and requiring little maintenance, prestressed concrete bridges deliver ***low-annual-cost*** service. Send for helpful free literature. It is distributed only in the United States and Canada.

Portland Cement Association

Dept. A2-13, 33 West Grand Avenue, Chicago 10, Illinois

A national organization to improve and extend the uses of portland cement and concrete through scientific research and engineering field work

THE SURVEYOR'S NOTEBOOK

Reporting on Unusual Surveying Problems and Their Solutions
Notekeeper: W. & L. E. Gurley, Established 1845

A Few "Tricks of the Trade"

Unusual Field Tips Suggested by Readers of "The Surveyor's Notebook"

A Louisiana engineer has come up with an interesting method of locating shot points during seismograph surveys. The shot location was practically inaccessible in the bayous. However, general direction was known from two points on a base. When the shot was sent off, considerable dirt and smoke were blown into the air; and two transits intersected the shot to give location close enough for practical purposes. (*Speaking of inaccessible sights,* the Gurley Telescopic Solar Transit quickly gets around obstructions with sun shots. Procedure of carrying a line forward with a Gurley Solar eliminates one man from a party. The time and labor saved "pay off" the instrument in a few seasons. Write for information on Model 112-RT.)

Gurley Telescopic Solar Transit

* * *

For night work, an automobile spotlight can aid the surveyor greatly. One engineer directs his vertically...uses suspended plumb lines at right angles to each other to plumb the beam. The beam is used for signaling when the transit party is to take the sight...sight is taken on the vertical beam when it appears in the sky.

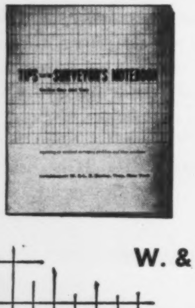
* * *

Some engineers ask for horizontal stadia lines on their transit reticles. This permits use of a horizontal rod—or even a common tape—for measuring distance. Using a right angle prism or Locke hand level with a right angle, a line is laid off perpendicular to the line of sight; and two targets such as pins or range poles are set on this line so that they are exactly matched to horizontal stadia. Distance between the two can then be measured, giving a means of determining stadia distance.

* * *

Can you use these field aids? *Gurley can supply 50-pound test yellow nylon plumb bob cord, to add to the visibility of your string in poor lighting. Also a cord adjustor, which helps you make quick changes in line length in the field. Send 25 cents in stamps or coin for a set of cord and adjustor with a drawing showing how to use them.*

* *



NEW EDITION OF "SURVEYOR'S NOTEBOOK": We have collected the most helpful, most discussed pages from Series One and Two of "The Surveyor's Notebook" in one 20-page book. These valuable field tips will help you use your own instruments with greater success. *Write for your free copy.*

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GURLEY Surveying and Scientific Instruments

comparing the performance of various types of prestressed and conventionally reinforced beams with respect to flexural behavior and ultimate strength. Inquiries should be addressed to the Research and Development Division of the Portland Cement Association, 33 West Grand Avenue, Chicago 10, Ill.

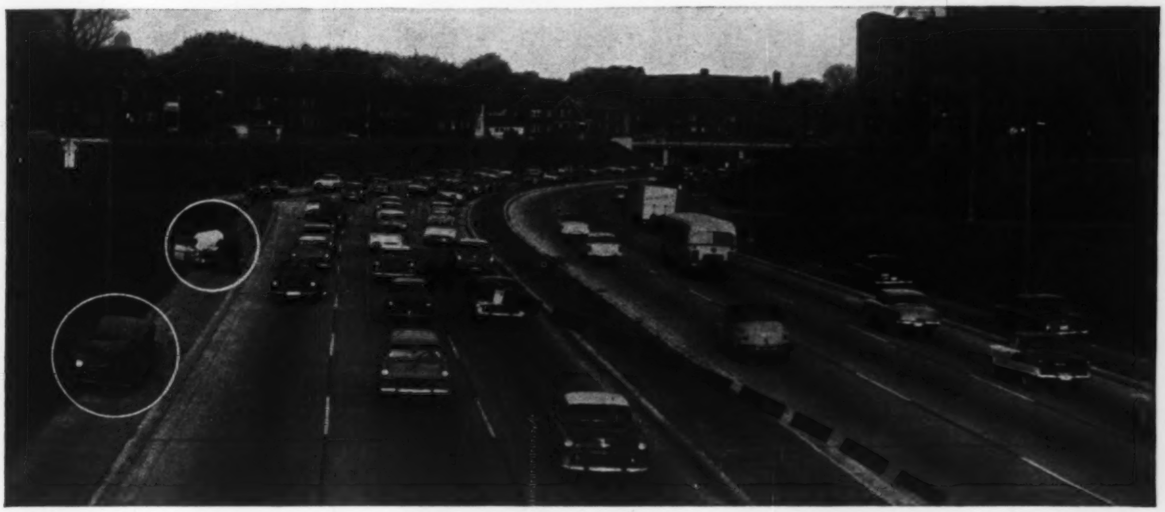
Beach erosion . . . A series of reports providing wave statistics for the coastal waters of the Gulf of Mexico is being issued by the Beach Erosion Board. Currently off the press are Technical Memoranda No. 85 dealing with "Wave Statistics for the Gulf of Mexico off Brownsville, Tex."; No. 86 covering "Wave Statistics for the Gulf of Mexico off Caplen, Tex."; No. 87 devoted to "Wave Statistics for the Gulf of Mexico off Burrwood, La."; and No. 88 concerned with "Wave Statistics for the Gulf of Mexico off Apalachicola, Fla." Inquiries should be sent to the Beach Erosion Board, Corps of Engineers, Department of the Army, Washington, D. C.

Plastics as building materials . . . For the convenience of the home owner and planner the Small Homes Council of the University of Illinois has released an eight-page circular describing the increasing part plastics play in home and factory building. Characteristics of the seven families of plastics commonly used for building products are described and their uses described. Copies sell for 10 cents each and may be obtained from the Small Homes Council, University of Illinois, Urbana, Ill.

Frost damage to highways . . . Design of pavement to minimize frost damage has been the subject of considerable research in recent years. A practical and theoretical approach to the problem is available in a recent book entitled "The Frost Penetration Problem in Highway Engineering" by Alfreds Richards Jumikis. The text is divided into three sections. Part 1 discusses the technical constituents of a highway body and the factors causing damage to it; Part II reviews the basic concepts of heat transfer in soil as related to single-layer and compound-layer systems; and Part III makes suggestions for remedial measures and the direction of future research. Copies are $5.00 each and may be obtained from the Rutgers University Press, New Brunswick, N. J.

Sewage treatment . . . Thirty-three papers on aerobic oxidation—presented at the 1955 Manhattan College Conference on Biological Waste Treatment—comprise the first in a proposed sanitary engineering series. The reference was edited by Brother Joseph McCabe and W. W. Eckenfelder, Jr., and published by the Reinhold Publishing Corporation. The proceedings of the 1957 conference devoted to anaerobic oxidation will constitute the second volume in the series. Inquiries should be addressed to the Director of Engineering Information, Manhattan College, Riverdale 71, N. Y.

Detroit, Wayne County install Armco Guardrail to halt head-on expressway crashes



Light-colored car (upper circle) leaped the divider strip and crashed head-on into an oncoming car (lower circle) at the spot marked "X". Both drivers were killed.

Just one week after the fatal accident, Armco FLEX-BEAM Guardrail was being installed along the median strip of the John Lodge Expressway.

A double-fatality accident last fall on the Detroit, Wayne County, John C. Lodge Expressway prompted fast action. Just days after the crash, crews were at work installing Armco FLEX-BEAM® Guardrail along the median strip of the six-lane divided highway.

A previous Armco Guardrail installation on Davison Expressway in Detroit had demonstrated its effectiveness. A local police official said, "In the three years before guardrail was installed on the Davison Expressway, there were 13 fatal accidents that could have been prevented with guardrail. Since the guardrail (Armco FLEX-BEAM) was installed in October, 1952, there have been *no* fatal accidents caused by cars jumping the center island on this highway."

FLEX-BEAM Guardrail is only one of many Armco products for drainage and construction work. Others include Corrugated Metal Pipe, MULTI-PLATE Pipe, Perforated Subdrainage Pipe, Retaining Walls, Steel Buildings, Pipe Piling, and Tunnel Liner. Write us for details. Armco Drainage & Metal Products, Inc., 3807 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. In Canada: write Guelph, Ontario. Export: The Armco International Corporation.

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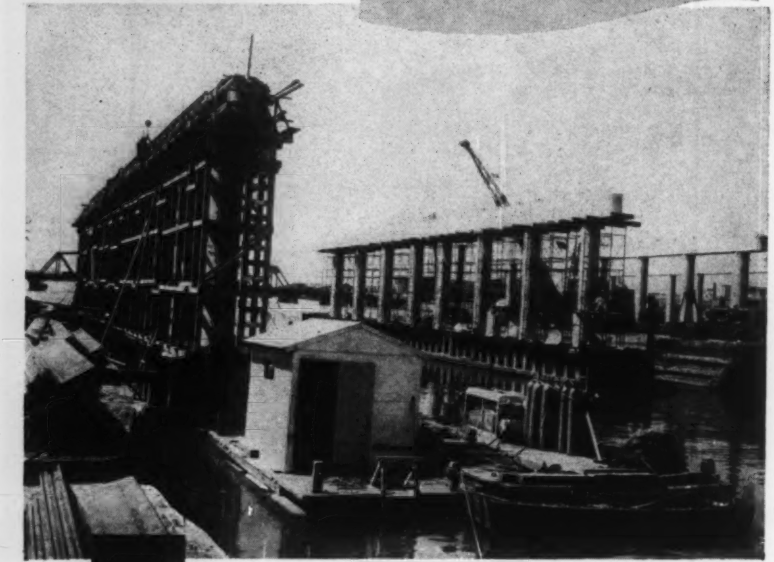
BRIDGE-BUILDING WITH LOW COST SONOTUBES!®



Providence River Bridge, North-South Freeway, Providence, R. I. Rhode Island Dept. of Public Works, Div. of Roads & Bridges. M. A. Gammino Company, contractors. Charles A. Maguire & Associates, Boston, consulting engineers. Photo: Courtesy New England Construction

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FIBRE FORMS
for round columns of concrete

The typical river bent for the Providence River Bridge included a concrete girder about 140 feet long supported on eight 36 inch diameter round concrete columns formed by SONOTUBES.

These columns, in turn, are supported by a solid granite-faced pier section resting on a heavy tremie seal foundation and long steel H-piles.

Figure on using SONOTUBE Fibre Forms on your next bridge-building job and save time, money and labor!

Low-cost SONOTUBES are available in practically all sizes up to 48" I.D. and to 48' long. Order in required lengths or saw to your specifications on the job.

Use Sonoco's patented "A-Coated" SONOTUBES for finished columns; wax-coated also available.

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Non-ASCE Meetings

American Concrete Institute. Fifty-third Annual Convention at the Statler-Hilton Hotel, Dallas, Tex., February 25-28. Information from Cedric Willson, Vice-President, Texas Industries, Inc., Dallas.

American Concrete Pipe Association. Forty-ninth Annual Convention at the Shoreham Hotel, Washington, D. C., March 5-9, 1957. Information from Howard F. Peckworth, Managing Director, American Concrete Pipe Association, 228 North LaSalle St., Chicago.

American Institute of Mining, Metallurgical, and Petroleum Engineers. Annual Meeting at the Roosevelt Hotel and Jung Hotel, New Orleans, La., February 24-28. Information from AIME, 29 West 39th Street, New York 18, N. Y.

American Power Conference. Nineteenth annual conference at the Hotel Sherman, Chicago, March 27-29, under sponsorship of the Illinois Institute of Technology and nine national and regional technical societies. Information from E. R. Whitehead, Secretary, American Power Conference, Illinois Institute of Technology, 3300 Federal Street, Chicago 16.

American Society of Heating and Air-Conditioning Engineers. Sixty-third annual meeting and international exposition in Chicago, February 25-March 1. Meeting at the Conrad-Hilton Hotel; exposition at the International Amphitheatre. Information from the Publicity Department, 13th International Heating and Air-Conditioning Exposition, 480 Lexington Ave., New York 17, N. Y.

American Society of Mechanical Engineers. Spring meeting at the Dinkler-Tutwiler, Birmingham, Ala., April 8-10. Information from the ASME, 29 West 39th Street, New York 18, N. Y.

American Society of Photogrammetry and **American Congress on Surveying and Mapping.** Annual meetings and co-exhibition of the two societies at the Shoreham Hotel, Washington, D. C., March 3-9. Information from ASP-ACSM, 1515 Massachusetts Avenue, N.W., Washington 5, D. C.

Connecticut Society of Civil Engineers. Annual meeting at the Waverly Inn, Cheshire, Conn., on March 21. Inquiries to E. T. Nettleton, Secretary-Treasurer,

(Continued on page 114)

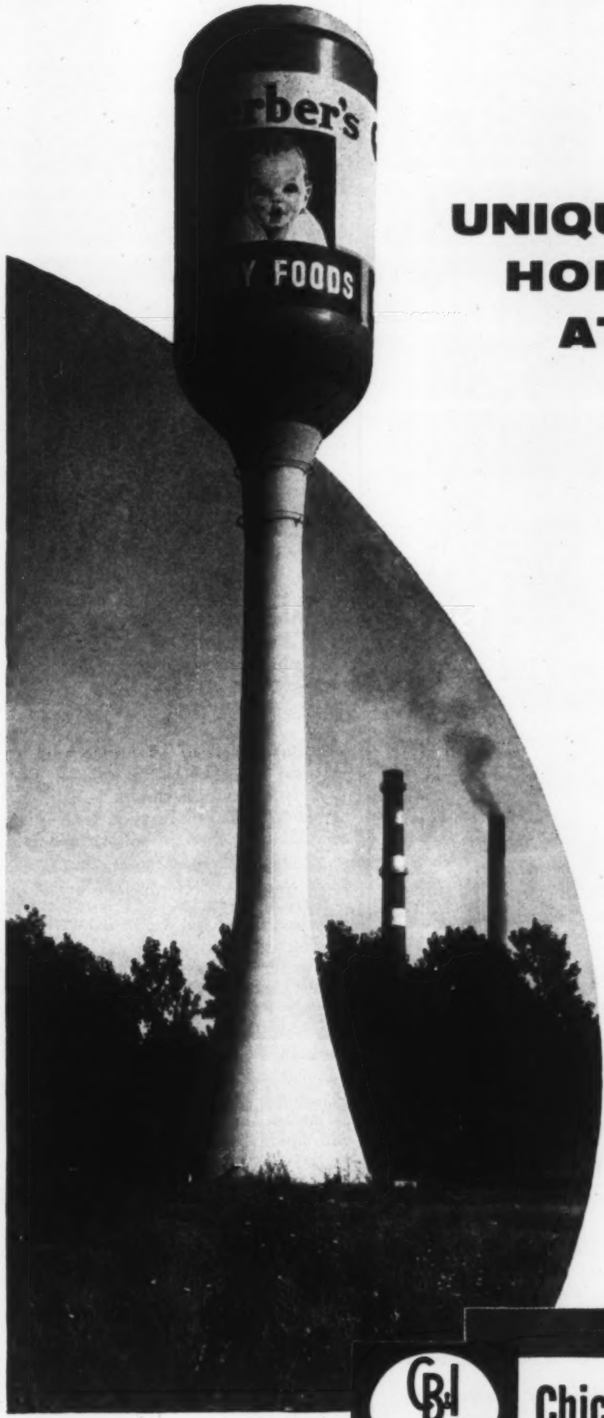
UNIQUE HORTON WATER TANK AT GERBER'S

It would be hard to measure the publicity value of the special Horton® water tank shown at the left, built for Gerber Products Inc. at Rochester, New York. A replica of the nationally known Gerber Baby Foods jar, it towers above the surrounding area.

This unique water tank provides a dependable, gravity pressure water supply that is always available—with the automatic plant sprinkler system, it provides maximum fire protection.

Investment wise, the water tank and plant sprinkler system will pay for themselves in approximately five years through reduced insurance premiums.

Write our nearest office for information on Horton elevated tanks of standard or unique design.



75,000-gal. Horton elevated water tank at Gerber Products, Inc., Rochester, N. Y.

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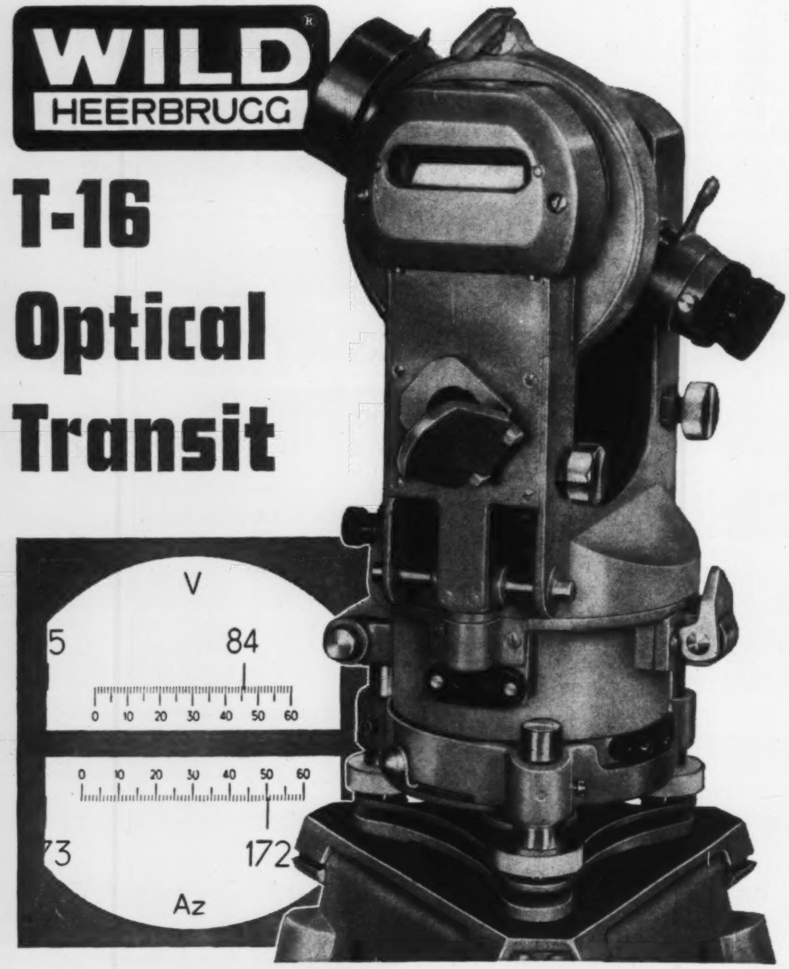

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T-16 Optical Transit

A brand new WILD *instrument that's breaking records for speed, accuracy, easy set-up and operation!*

The T-16 embodies many brilliant new concepts. They add up to a degree of optical and mechanical precision, as well as versatility, that you'll find *impossible to duplicate with any other instrument at this price.*

NOTABLE FEATURES OF THE WILD T-16

- Direct scale reading to 1 minute; interpolation to 20 seconds.
- Azimuth and vertical scales seen simultaneously and read directly.
- Built-in repeating clamp for setting on zero. Eliminates lower plate motions.
- New optical plumb with upright image to speed setting up.
- Optional accessories include battery box providing illumination for scales, level vials and telescope reticle.
- Excellent for mining, highway and land surveying.

PRICE: $700 F.O.B. Port Washington, N. Y. Tripods extra. Write for Booklet T-16

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Non-ASCE Meetings

(Continued from page 112)

Connecticut Society of Civil Engineers, P.O. Box 6186, Hamden 17, Conn.

Georgia Institute of Technology. Sixth Annual Georgia Highway Conference at the Georgia Institute of Technology, Atlanta, Ga., February 25-26. Information from Radner J. Paquette, Professor, School of Civil Engineering, Georgia Institute of Technology, Atlanta, Ga.

Highway Engineering Conference. Thirtieth Annual Highway Engineering Conference of the University of Colorado in the Forum Room of the University Memorial Center in Boulder on February 28 and March 1. Inquiries to Roderick Downing, Conference Chairman, University of Colorado, Boulder, Colo.

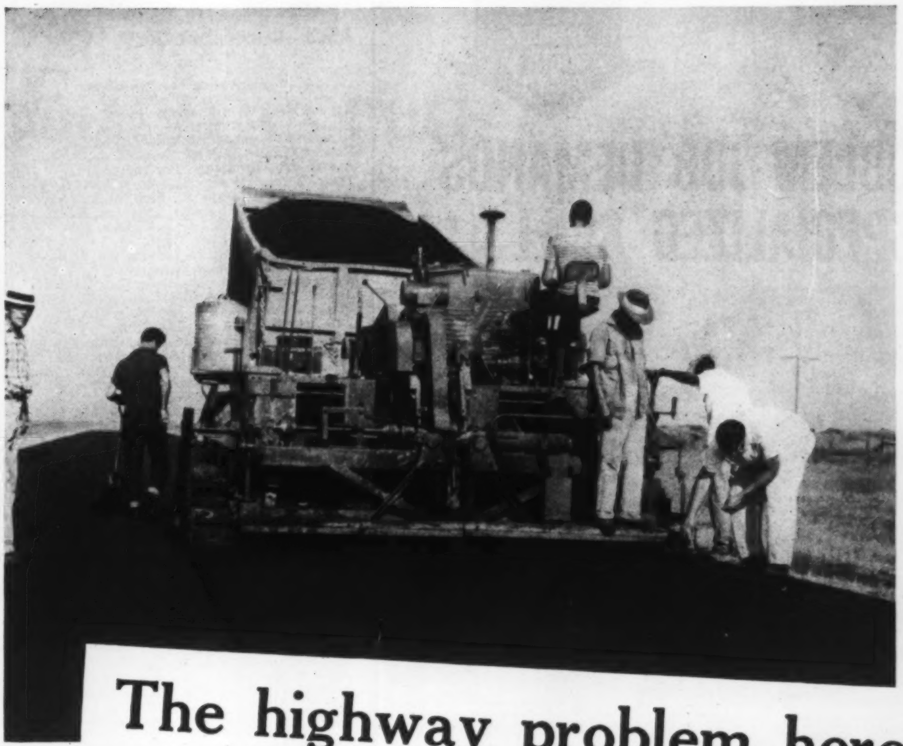
Louisiana State University. The 1957 Conference on High-Speed Computers at Louisiana State University, Baton Rouge, La., March 5-8. Information from Dr. J. W. Brouillette, Director, General Extension Division, Louisiana State University, Baton Rouge 3, La.

National Society of Professional Engineers. Spring Meeting at the Hotel Francis Marion, Charleston, S. C., February 15-16, 1957. Information from NSPE, 2029 K Street, N.W., Washington 6, D. C.

Nuclear Congress. 1957 Nuclear Congress sponsored and conducted by twenty leading engineering and scientific societies under the coordination of Engineers Joint Council at Convention Hall, Philadelphia, Pa., March 11-15, 1957. Information from EJC, 29 West 39th Street, New York 18, N. Y.

Purdue University. Purdue University will hold the first symposium devoted exclusively to the presentation of management findings in the field of transportation at Lafayette, Ind., February 27 and 28, under the sponsorship of the Institute of Management Sciences, the Operations Research Society of America, and the American Institute of Industrial Engineers, Inc. Inquiries to Prof. A. Charnes, Director of Research, Department of Industrial Management and Transportation, Purdue University.

Washington University. One-day Conference on Good Concrete and the Role of Admixtures, offered by the Department of Civil Engineering and University College, will be presented in Brown Hall Auditorium, Washington University on February 16. Further information concerning course content, instructors, and registration from University College, Washington University, St. Louis 5, Mo.



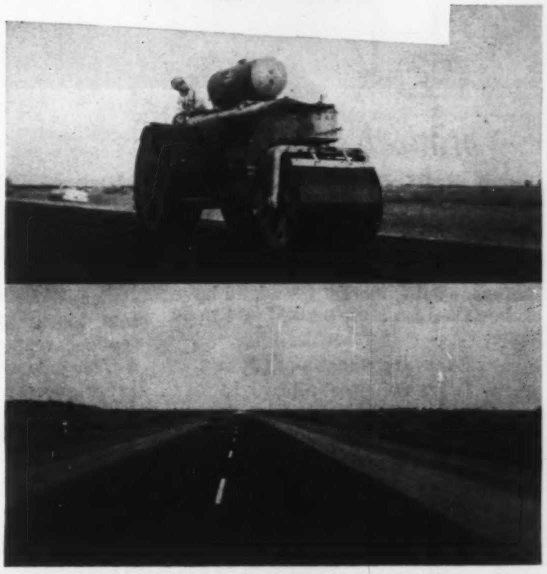
Laying hot-mix Texaco Asphaltic Concrete wearing surface over a sand-shell base and sand-loam sub-base on 19 miles of Texas State Route 73.

CONTRACTORS

F. & C. Engineering Company, Inc., Houston, prime contractor.

Gulf Bitulithic Company, Houston, asphalt contractor.

The highway problem here was a low-bearing-value subgrade



Texas is building a shorter highway link between Houston and Port Arthur's large oil refineries. A major problem in the construction of the 19-mile section shown here was the low bearing value of the underlying subgrade.

The answer to the problem was a completely flexible highway, from the subsoil up. Selected material, sand-loam, was laid to a thickness of 12 inches on the subgrade. Next came a sandshell base 10 inches thick, primed with Texaco MC-1 Cutback Asphalt. A 2-inch wearing surface of hot-mix Texaco Asphaltic Concrete completed the project.

The top-to-bottom flexibility of such a highway assures complete and continuous contact with the subgrade, resulting in greater durability and lower upkeep cost.

Whether the project is a State Highway in Texas, a landing surface for guided missiles in Florida, or a heliport for military helicopters in Virginia, there is a type of Texaco Asphalt construction exactly suited to the requirements. Helpful information on methods and materials recommended for all asphalt pavement types is supplied in two booklets. Copies may be secured without obligation by writing our nearest office.

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1. Excavation is sheeted and braced.
2. Pretest cylinders underpin adjacent structures. Foundation consists of piles and open piers.

Project: New Equipment Bldg. for Southern New England Telephone Co., Bridgeport, Conn.
Architects: Davis, Cochran & Miller, New Haven, Conn.
Engineer: Henry A. Pfisterer, New Haven, Conn.

On a foundation job like this, it might well be thought that several different sub-contractors would have to be called in. Here's what had to be done.

- Excavate, sheet and brace.
- Drive 295 steel piles.
- Install open piers.
- Underpin adjacent structures with 12 Pretest cylinders.

Actually, Spencer, White & Prentis successfully performed all these operations. Wouldn't it be to your advantage too, to use this system of centralized responsibility?

You deal with a single specialist, experienced with every type of foundation problem . . . and offering all the specialized personnel and equipment to assure dependable results.

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Applications for Admission to ASCE—December 8-29, 1956

Applying for Member

Robert Theodore Alexander, Washington, D.C.
Edward Goin Andrews, Augusta, Ga.
John Blazer Archer, Charleston, W. Va.
Roland Michael Austin, Jamestown, N. Y.
Albert Paul Backhaus, Baltimore, Md.
Percy Samuel Boughton, Asbury Park, N. Y.
John Marshall Budd, St. Paul, Minn.
James Archibald Campbell, Berryton, Kans.
Charles Elard Carl, Pierre, S. Dak.
Clifford Gatzert, Lodi, Calif.
Lyman Ridgway Gillis, Los Angeles, Calif.
Thomas Page Heritage, Greensboro, N. C.
Rush Alfonso Kelso, Atlanta, Ga.
Albert Norman Laird, Dearborn, Mich.
William Elmer Lorenz, St. Louis, Mo.
Ben Mayeron, Minneapolis, Minn.
Kenneth Leslie Morgan, Juneau, Alaska.
Alton Lee McWhorter, Birmingham, Ala.
Warren Fredrick Muncie, Prairie Valley, Kans.
Martin William Oettershagen, Buffalo, N. Y.
Elmo Howell Orange, Norfolk, Va.
Robert Frederick Pfaff, Baltimore, Md.
Glenn Almon Rossiter, Edgeworth, Pa.
Henry Carl Schrader, Ft. Monroe, Va.
William Edwin Squire, Miami, Fla.
John Howard Swanberg, New Brighton, Minn.
Charles Everett Trygg, Seal Beach, Calif.
Edward Von Geldern, Honolulu, T. H.

Applying for Associate Member

Enrique Baez, Jr., Hato Rey, Puerto Rico
Richard Hugh Bigelow, Wilmington, N. C.
Nicolas Bittenbinder, Great Neck, N. Y.
James E. Bray, Corpus Christi, Tex.
Frank Cook, Watertown, N. Y.
John Cook, Watertown, N. Y.
William Albert Crabb, Kansas City, Mo.
Julio Marquez Cruz, San Juan, Puerto Rico.
Kikubhai Pragji Desai, London, England.
Rudolph Conrad Dodl, Lynchburg, Va.
Victor Eugene Futhey, Corpus Christi, Tex.
Panagiotis Gondikas, New York, N. Y.
Charles Gray Grosvenor, Jr., Santa Fe, N. Mex.
Robert Louis Haenel, New York, N. Y.
Robert Wareham Lamberton, Kansas City, Mo.
Allen Lim, El Cerito, Calif.
Robert Edward Martin, Walla Walla, Wash.
Albert August Mastriani, Albany, Ga.
John Stuart McComb, Santa Fe, N. Mex.
Bertrand Kermit Melton, Clinton, Mass.
Shah Mohammad, Berkeley, Calif.
James Gray Norman, Juneau, Alaska.
John William O'Hara, Denver, Colo.
Anthony Papachis, Nashville, Tenn.
Samuel Joseph Ruff, Jackson, Miss.
Raj Pal Sehgal, Pepsu, India.
Howard Ross Slaney, Jr., Newark, Del.
Hsi Hsin Tung, New York, N. Y.
Clarence Palmer Ulstad, Pittsburgh, Pa.
Billie Gee White, Augusta, Ga.
Vernon Stanley Winkel, Wichita, Kans.

Applying for Affiliate

Theodore Dickson Bolling, New York, N. Y.

Applying for Junior Member

Alfredo Ang, Urbana, Ill.
Shalom Blaj, New York, N. Y.
William Bootz, Detroit, Mich.
William Emmett Buchanan, Vicksburg, Miss.
Filadelfo Chamorra, Managua, Nicaragua.
Robert Alexander Collins, Urbana, Ill.
Hamilton Gonzaga De Oliveira, Denver, Colo.
William Harold Desmond, Chicopee Falls, Mass.
Jorge Jesus Oscar Guevara, Hollywood, Calif.
Stanley Hancock Hillyer, Milan, Italy.
Carl John Huval, Vicksburg, Miss.
Albert Watson Irwin, Portland, Ore.
Richard Herman Jann, Madison, Wis.
Ralph Waller Leidholdt, Grand Forks, N. D.
James Grierson MacGregor, Urbana, Ill.
Robert Rankin McBride, Jr., Dallas, Tex.
Joseph John Sciacca, Bayonne, N. J.
Murray David Segal, Tallahassee, Fla.
John Allen Scoville, Jr., Glenview, Ill.
Carol Scott Shillite, Bogota, Colombia.
Cornelis Arie Van Dam, St. Mary's N.S.W., Australia.
Luel Tresmer Watkins, Kingsville, Tex.
Eugene Anthony Wirkus, Sun Valley, Calif.
Loren Milton Womack, Vicksburg, Miss.
Kosti Yoanidis, Boston, Mass.
John Paul Zedalis, Middletown, Conn.

Applications for Junior Membership from ASCE Student Chapters are not listed.

Engineered construction sales are made by reaching you!

To meet the challenge of today's record engineered construction boom means a never ending search for new and improved construction equipment, installed equipment, materials and supplies. Civil engineers who influence, specify, and buy for engineered construction read the advertisements in CIVIL ENGINEERING because they contain information of value to them in their work.

Only CIVIL ENGINEERING reaches, informs, influences and sells 39,000 civil engineers, 90% of whom have met the rigid ASCE requirements for membership. Average reading time is nearly 3 hours per issue.

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Important Facts from two Studies by the Construction Division of The American Society of Civil Engineers

1. American Society of Civil Engineers members are dominant in all fields of engineered construction—26 major types of projects specifically mentioned.
2. One or more of almost all types of construction equipment are used by Civil engineers on these construction projects.
3. Civil engineers have a major influence in the specification of practically all construction material and installed equipment required to complete the 26 major types of projects.
4. Civil engineers are highly brand conscious and have definite brand preferences for virtually all construction materials and equipment.
5. Civil engineers hold important executive positions and have responsible charge of work in all areas of construction.
6. Civil engineers consult frequently and extensively with their opposite numbers in other organizations in the process of specifying and buying.
7. Civil engineers hold important positions in contractor organizations and select or directly influence the purchase of equipment.
8. Civil engineers in consulting or awarding agencies also influence equipment purchases.
9. Civil engineers spend almost twice as much time reading their Society magazine, CIVIL ENGINEERING, than any other business publication.

Engineers are educated to specify and buy!

CIVIL ENGINEERING

Published by

The American Society of Civil Engineers
33 West 39th Street, New York 18, N. Y.

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NEW YORK	CHICAGO	DETROIT	SAN FRANCISCO
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This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient non-profit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

Men Available

Structural Engineer, A. M. ASCE; M.S. in C.E.; age 33; 8 years' civil engineering experience. Structural design and supervision of reinforced concrete and steel, commercial, institutional, industrial, and hydraulic structures in the U. S. and abroad. Last 3 years partner in small office. Well versed in U. S. and European design and bid practices. Multi-lingual. Interested in connection with progressive engineering firm with opportunities for advancement. Location desired, New York Metropolitan area or San Francisco Metropolitan area. C-182.

Instructor, J. M. ASCE; B.S., M.S.; age 30; 2½ years' experience in reinforced concrete (buildings and industrial equipment foundations). Location desired, New York City area; will consider position in Illinois. C-184-764-Chicago.

Association or Society Secretary, Aff. ASCE; age 53; 23 years' administrative and public relations, writing, editing, publicizing, arranging meetings. Keep minutes. Conduct office. Location immaterial. C-185.

Registered Civil Engineer, J. M. ASCE, AIME; B.S. in C.E.; age 27; 7 years' professional experience, plant engineering and production engineering at large chemical plant; officer in Corps of Engineers; mineral exploration and triangulation; underground hardrock mining. Will travel 30 percent of time. Considerable technical writing experience. Some Spanish. Available immediately. Desires position in mining or plant engineering. Location desired, western U. S. or foreign. C-186.

Civil-Management Engineer, J. M. ASCE; B.C.E., B. Man.E. (R.P.I.); age 31; 9 years' professional experience in technical administrative and staff capacity. Experienced in construction management engineering and industrial management engineering. Recent industrial plant engineering partnership for export of machinery and services to, and construction and installation of facilities in, Latin America. Location desired: Domestic or overseas. C-187.

Civil Engineer, A.M. ASCE; B.S.C.E.; registered; 35, married; 4 years Navy; 6 years' diversified experience in heavy construction; 2 years' design and production of precast and prestressed concrete structural members. C-188.

Positions Available

Teaching Personnel for Department of Mechanics; B.S. in engineering required, master's degree preferred. No teaching or industrial experience necessary. Salary, $4,000-$6,500 for nine months; rank and salary dependent upon qualifications. Location, Southwest. W-4258.

Instructors in civil engineering, to teach service courses in analytical mechanics, strength of materials, hydraulics. Preferably M.S. degree. Salary and rank will depend upon education and experience; nine months' teaching. Location, West. W-4301(*a*).

Structural Engineer to head up structural design department of medium-size architect's office, with a practice consisting primarily of industrial, commercial, and institutional work and schools. Excellent permanent opportunity. Apply by letter giving full information. Location, Gulf-South area. W-4306.

CIVIL ENGINEERS
for work in SOUTHEAST ASIA

Personnel needed to complete technical party. Work involves design and supervision of construction of highways and bridges in South Vietnam. Duties include instruction of on-the-job trainees. High degree of initiative, judgment and skill in handling human relations required in addition to professional competence. All personnel must be experienced and able to provide references. Eighteen-month minimum employment contract. Housing furnished. Dependents authorized to accompany except in case of field personnel. Only those interested in difficult and challenging work should apply. The following positions are open:

Highway and Bridge Designers
Draftsmen
Highway Construction Engineers (Field)
Party Chiefs (Field)

The following listed personnel will be chosen from Engineers having a long and successful record of experience in responsible assignments. They will be assigned to assist the Government of Vietnam in organizing a Department of Highways in the Ministry of Public Works for the planning, administration, coordination and supervision of all highway activities and appurtenant services:

Highway and Bridge Engineers
Materials Engineer
Program and Planning Specialist

Opening also available for both field and office personnel at various stateside locations, in connection with the above and other important highway projects.

For Application Blank Write To:

Capitol Engineering Corporation
Consulting Engineers
DILLSBURG, PENNSYLVANIA

CIVIL ENGINEERS
DESIGNERS
DRAFTSMEN

Opportunity for continuing employment in all grades in our design offices located in Louisville, Cincinnati, Chicago and Lansing for graduate engineers with or without experience and individuals with practical backgrounds for work on major bridges and expressway projects.

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Overtime allowance, annual vacation with pay, holiday time, allowance for sick leave, insurance and retirement plan, Blue Cross available.

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Desirable living and working conditions. Ample opportunity for advancement to positions of responsibility.

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Please give detailed personal and experience record, competent references and salary expected in first letter.

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Consulting Engineers
405 Commerce Building
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Structural Designers
Structural Draftsmen
Highway Designers

RECENT GRADUATES

For highway design in New York City and New Jersey

Permanent positions with opportunity for advancement

Company paid Life Insurance, Pension Plan

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468 Fourth Avenue,
New York City

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Woodbury, N. J.

CIVIL ENGINEERS

New positions created in Madison, Wis. Graduate engineer with some experience to begin in Engineering Dept. at about $455 a month. Annual and longevity increases to $563. Office and field work in design and construction of sewer, water, street, sidewalk and curbs. Possession of Engineer-in-Training Certificate required. No residence restrictions for man to begin work. Wisconsin Retirement Fund and Social Security Benefits.

Write

Personnel Department
City Hall, Madison 3, Wis.

Assistant Editor, graduate civil, preferably two years out of college, with some experience in writing for technical engineering magazine. Salary, $6,000-$7,000 a year. Location, New York, N. Y. W-4311.

Assistant Editor, civil or chemical engineering graduate, with experience in water supply sewage and industrial waste treatment fields. Salary, $7,000 a year. Location, New York, N.Y. W-4322.

Instructors-Assistant Professors, B.S. or M.S. in civil engineering, to teach a variety of civil engineering subjects. Previous teaching experience not required. Positions available in February or September 1957. Salary and rank dependent upon qualifications. Location, West. W-4327.

Engineers: (*a*) Construction Engineer, with at least 5 years' office engineering experience in chemical process fields. Considerable traveling. Salary, to $9,500 a year. (*b*) Field Engineer, 25-30, enginereing graduate with process construction experience. Considerable traveling. Salary, $5,000-$6,000 a year. Company pays placement fees. Headquarters, eastern Pennsylvania. W-4328.

Foundation Engineer, graduate civil, for hydroelectric project. Must have at least 10 years' experience, some of which should have been on concrete dams. Grouting experience desirable. Salary, $10,800-$12,000 a year plus living allowance. Two-year contract. Single status preferred or just man with wife as no school facilities are available. Location, Turkey. F-4336(*a*).

Engineers, Designers and **Designer-Draftsmen** in the following fields: (*a*) Highways, design and plans for interstate highway system work. (*b*) Structural, highway structures. (*c*) Sanitary. (*d*) General civil. Will consider older men. Location, South. W-4345.

Civil Engineer to work as assistant in sponsored research on soils. Opportunity to do graduate work tuition free. Location, New Jersey. W-4348.

Plant Engineer, over 40, civil engineering graduate, with at least 5 years' industrial plant layout and construction experience. Salary, $8,000-$10,000 a year. Location, southern Connecticut. W-4367.

Administrative Civil Engineer, 40-52, graduate, with experience in waterfront construction. Ability to make surveys, studies, and to present sound recommendations is essential; will do considerable pier and warehouse construction. Salary open. Location, Maryland. W-4389.

Engineers, civil or mining, under 30, with some industrial experience, for open-pit, nonmetallic operations. Salary, to start, $6,000 a year, with fringe benefits. Locations, Southeast or Midwest. W-4395.

Maintenance Engineers, civil or mechanical, with 1 to 2 years' industrial experience, for improvement and inspection for retail-store chain. One will be district field engineer and one office engineer on store specifications, layouts, etc. Salaries, $6,000 a year. Headquarters, New York, N. Y. W-4396.

Senior Structural Engineer, civil or architectural engineering graduate, with at least 10 years' design experience covering structural steel construction, prefabricated panels and fabrication of light-gage metals. Salary, $8,000-$12,000 a year. Location, Midwest. W-4400(*b*).

Civil Engineers. (*a*) Office Engineer, graduate, for railroad. (*b*) Assistant Engineer, graduate, also needed. Apply by letter stating age, references, experience, education, salary required. Location, New England. W-4421.

Instructor or **Assistant Professor**, master's degree in civil engineering, to teach structures as a specialty. Salary, $4,500-$6,500 for academic year. Location, New England. W-4423.

Senior Structural Designer, civil graduate, with at least 5 years' experience on design and specifications covering drydocks, piers, or general marine construction. Salary, $7,200-$8,400 a year. Location, New York, N.Y. W-4429.

Structural Department Head, civil graduate, with at least 10 years' senior design and supervisory experience covering industrial and process buildings. Salary, $9,000-$11,000 a year. Company pays placement fee. Location, New Jersey metropolitan area. W-4431.

(Continued on page 120)

STRUCTURAL

ENGINEERS
DESIGNERS
DRAFTSMEN

Prefer several years' experience in any of these fields:

BRIDGES

BUILDINGS
EXPRESSWAYS
HYDRO PROJECTS
TEST FACILITIES *

Will consider lesser experience with good educational background. Several recent graduates will be added to our structural staffs to round out this planned expansion program. Occasional openings for combination men in construction supervision and inspection; must be free to move and to assume office duties between assignments.

Sverdrup & Parcel, Inc., are professional engineers engaged primarily in design work covering a wide scope of practice. The variety and unusual character of our work, including as an example the proposed world's largest bridge project, offer excellent opportunities for individual and professional development and advancement.

We need a large number of men for our general offices in St. Louis and several for our branch office in San Francisco. These are permanent additions to our regular staffs. Confidential interview can also be obtained at Washington, D. C., and Portland, Oregon.

Paid vacation, sick leave, holidays, overtime. Employee Benefits Plan furnishes retirement income plus life and disability insurance. Blue Cross. Moving allowance.

Please write fully, including salary data, to

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* We are designers of the technical facilities for the Arnold Engineering Development Center, operated by our subsidiary, ARO, Inc.

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Expanding flood control program accompanying rapid industrial and residential growth in beautiful Orange County 35 miles southeast of Los Angeles.

ASSOCIATE CIVIL ENGINEERS $575—$715

Project planning or structural and hydraulic design. California registration. College degree and 3 years experience.

ASSISTANT CIVIL ENGINEERS $489—$608

Equivalent to college degree and six months experience (summer work acceptable).

Orange County
Personnel Department
644 North Broadway
Santa Ana, California

STRUCTURAL ENGINEER

Civil Engineer (Degree required) for qualified young man (40 or under) working with high voltage outdoor structural steel sub-stations, designing of beam and lattice type structures in steel and aluminum including estimating and supervising of shop drawings. Excellent opportunity and top salary in our expanding manufacturing organization. Fully paid benefit programs.

Write or phone, giving full particulars:

G. A. Gurney, Personnel
DELTA-STAR ELECTRIC DIVISION
H. K. Porter Company, Inc. of Pittsburgh
2437 W. Fulton Street
Chicago 12, Illinois
SEeley 3-3200

Men And Jobs Available

(*Continued from page 119*)

Civil Engineers, graduates, 35-60, with structural background. Must be familiar with Army Engineers' procedures. Available for immediate assignment. Salary, $12,000 a year plus living allowance. Location, Formosa. F-4438.

Structural Design Engineers with experience in highway, bridge and building structural design. Salaries open. Location, central Pennsylvania. W-4460.

Director of Public Relations for an engineering society. Should have minimum of 5 years' previous experience in this work either in industry or trade association. Salary open. Location, western Pennsylvania. W-4464.

Technical Editor to handle extensive publication program on international engineering organization. Well-rounded background and experience in technical editing, printing and publications production essential. Apply by letter submitting full résumé and desired starting salary. Location, Maryland. W-4494.

Engineers. (*a*) Senior Designer, civil graduate, with experience on site planning for large industrial plants, railroad yards, dock facilities, and bulk materials handling. Salary, to $9,500 a year. (*b*) Specification Engineer with experience covering preparation of structural and architectural specifications and requisitions for power, chemical, and industrial plants. Salary, to $9,000 a year. (*c*) Schedules Engineer with industrial construction experience covering planning, scheduling and preparation of manpower and progress curves. Salary, to $7,500 a year. Location, New York, N. Y. W-4496.

Civil Engineer, 25-30, graduate, with either structural or civil engineering background, with a minimum of 6 years in engineering work, 2 years of which must have been in design. Design experience in industrial construction and of the type gained in consulting work. Work will include design of foundations and structures for marine and dockside facilities, industrial and power plant buildings, and equipment foundations. Salary, $6,000-$8,400 a year. Location, Virginia. W-4502.

Highway Engineers for a consulting engineering firm. (*a*) One Bridge Engineer and one Highway Engineer with experience in designing, supervising and coordinating staff of design engineers. Salaries, $7,200-$8,400 a year. (*b*) Highway Structures and Bridge Design Engineers and Highway Design Engineers with 3 to 5 years' experience in these fields. Salaries, $6,000-$7,200 a year. Apply by letter giving complete data, date of availability, etc. Location, West. W-4503.

Instructor, graduate civil, for duties including lecturing, laboratory supervision, and also assisting for three weeks at a surveying camp; subjects of instruction are first-year engineering drawing, a second-year course in surveying, and a course in materials of construction. Previous teaching experience not essential. Write giving full details of training and experience. Temporary, from August 1957 to mid-May 1958. Salary, for this period, $4,450. Location, Canada. W-4507.

Structural Designer, B.S. C. E. or Architectural Engineer, about 28, with 3 years in engineering office with similar duties; knowledge of design and drafting. Duties will include structural design of steel, concrete and timber for industrial buildings. Checking of structural shop drawings; some structural drafting. Approximately 60 percent structural design, 40 percent drafting. Company manufactures paints. Salary, $8,400 a year. Company pays placement fee. Location, Chicago. C-5626.

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Offers engineers liberal relocation allowances from the point of employment to the engineering office of your selection. These allowances include transportation for you and your family plus moving allowances for your household furnishings.

Immediate Opportunities

ENGINEERS

STRUCTURAL – HYDRAULIC

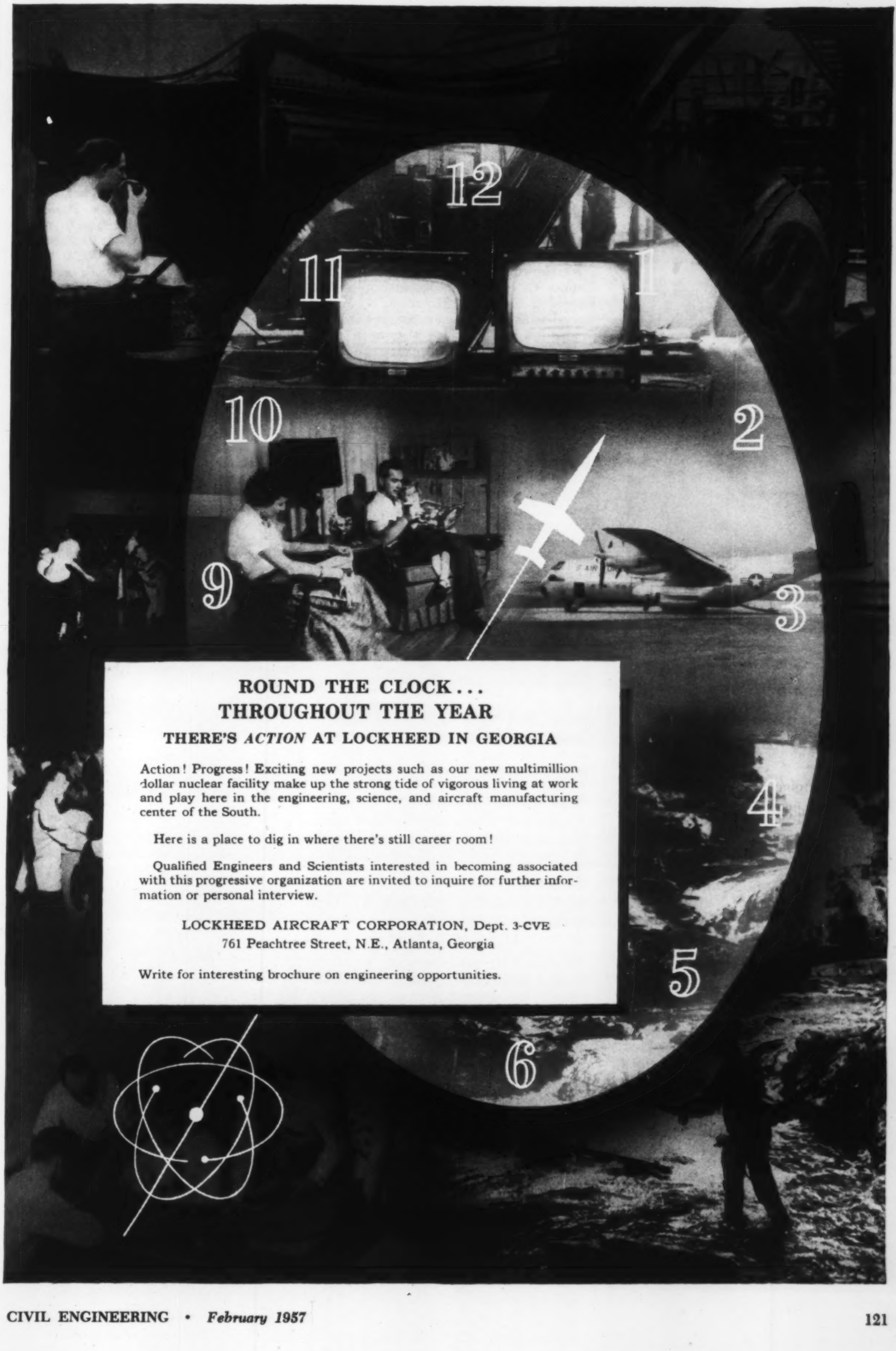
San Francisco opportunity for structural engineers with experience on steam power generating plants, petroleum refineries, or related projects.

Los Angeles offers immediate opportunities for structural or hydraulic engineers whose experience is related to steam or hydro power generating plants. Related experience acceptable.

Send resume to Manager of Employment & Placement Industrial Relations Division

BECHTEL CORPORATION
220 Bush Street
San Francisco 4, California

For an immediate personal interview you may phone:
Paul Keating, Murray Hill 7-7100, New York City
Joe Braddick, Fairfax 3-2401, Houston, Texas
Bill Milligan, Tucker 1549, Los Angeles, Calif.
Don Palmer, Douglas 2-4032, San Francisco, Calif.



ROUND THE CLOCK ... THROUGHOUT THE YEAR

THERE'S *ACTION* AT LOCKHEED IN GEORGIA

Action! Progress! Exciting new projects such as our new multimillion dollar nuclear facility make up the strong tide of vigorous living at work and play here in the engineering, science, and aircraft manufacturing center of the South.

Here is a place to dig in where there's still career room!

Qualified Engineers and Scientists interested in becoming associated with this progressive organization are invited to inquire for further information or personal interview.

LOCKHEED AIRCRAFT CORPORATION, Dept. 3-CVE
761 Peachtree Street, N.E., Atlanta, Georgia

Write for interesting brochure on engineering opportunities.

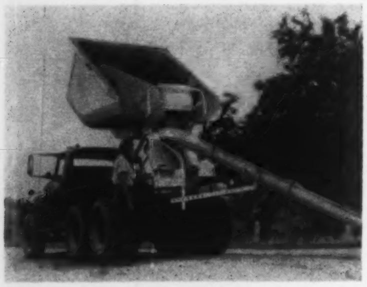
EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Specially Designed Body

Dumpcrete—the only body specially designed to haul concrete, without agitation, from central mixing plant to paving, structures or heavy construction jobs—has been redesigned for increased flexibility.

The new double-duty body now meets the individual job requirements of contractors. It can be mounted on light, single-axle trucks to handle loads up to 4-cu yds or on tandem-axle trucks to handle loads up to 6-cu yds. Contractors can match their equipment to job requirements or mixing plant output, and vary the Dumpcrete mounting from job to job.



Dumpcrete

All original features have been retained in the new design. The body offers a jackknife chute that swings in a 180-deg angle for pinpoint placement, variable control of dumping angle with 90-deg dump angle for clean discharge, controlled discharge of full load in 30-sec or 30-min, one-man operation, and all-welded high tensile steel body that is completely watertight. Simple removal of chute and gate assembly changes Dumpcrete into an all-purpose utility body that can be used to haul gravel, sand, water and dirt. **Manufacturing Division, Maxon Construction Co., Inc., CE 2-122, Dayton 1, Ohio.**

Wax Coated Plows

Plowing equipment that has been coated with Penn Drake Snow Plow Wax moves more snow faster, easier and more economically, according to the manufacturer. One gallon of the special compound is said to be enough to cover 300-sq ft. The wax is brushed or sprayed on the moldboards and wings. It is also recommended for such other snow removal equipment as snow loaders, rotary plows, dump boxes and the like. The compound forms a hard, slick coating which permits the snow to slide off easily, wet or dry. **Pennsylvania Refining Co., CE 2-122, 2660 Lisbon Road, Cleveland 4, Ohio.**

105mm Micro-Master

The 105mm micro-master film system, the first ever designed exclusively for the reproduction of large engineering drawings up to 36 by 54-in. in size and even longer, is a versatile medium.

Developed by Micro-Master, Inc., Kansas City, Mo., in association with Keuffel & Esser Co., Hoboken, N. J., it embodies an entirely new concept in reproduction and provides a series of advantages that make it superior to any existing reproduction process including 70mm.

It yields full-sized second originals on Photact papers and cloth or on Stabilene film of such high quality that original pencil or ink tracings may be safely destroyed.

Second originals made from 105mm have been consistently better in quality than the true originals. In addition, the process can restore most worn or soiled tracings, yielding a 75 percent improvement on the average—without artwork—as a result of the advanced optics and precise processing used in Micro-Master.

The larger 105mm negative (nominally 4 x 6-in.) is big enough to be identified and read with the naked eye, except in the case of highly complex drawings.

The low magnification of a hand glass is always sufficient to establish identification. Economical 4 x 6-in. contact Card Prints are available for separate filing and indexing and in instances where a positive is preferred to a negative.

The size of Micro-Master negatives was designed to fit standard 5 x 8-in. steel filing drawers. As a result, filmed drawings can be stored in approximately 1/25 of the space that the tracings themselves would need. **Keuffel & Esser Co., CE 2-122, New York 16, N. Y.**

Leveling Rod

A new engineers' leveling rod featuring a vernier on the target reading to 1/000-ft has been added to the company's line.

The 3-section rod which is 10-ft long and is graduated in feet, tenths and hundredths of feet, has cast oval red and white enameled target with a tension gib and locking screw. Easily portable on the job or in the car, the rod is in three separate sections interlocked with positive locking plates. It can also be used in two sections for heights up to 6.7-ft. Graduations are deeply engraved for permanence and are highly accurate. Tenths of feet and graduations between are marked in black on a white background, while feet are indicated in red. **C. L. Berger & Sons, Inc., CE 2-122, 37 Williams St., Boston, Mass.**

Pattern Sheet Copper

"Ripple" pattern sheet copper, a new stock design metal, is now available to architectural, building, sheet metal and similar industries. It comes in standard 16-oz weight, in 36 x 96-in. sheets. Ideal for both interior and exterior applications, the new Chase "Ripple" pattern sheet copper features a deep ripple, or wave design which produces sparkling highlights and interesting shadow patterns. For exterior use, both cornices and box gutters on residences take on a shimmering new beauty when formed of this pattern copper. Inside uses suggest themselves: fireplace hoods, range canopies, flower boxes, paneling, wood baskets—adding a beauty beyond that of plain sheet copper. **Chase Brass & Copper Co., CE 2-122, 236 Grand Street, Waterbury 20, Conn.**

Backhoe

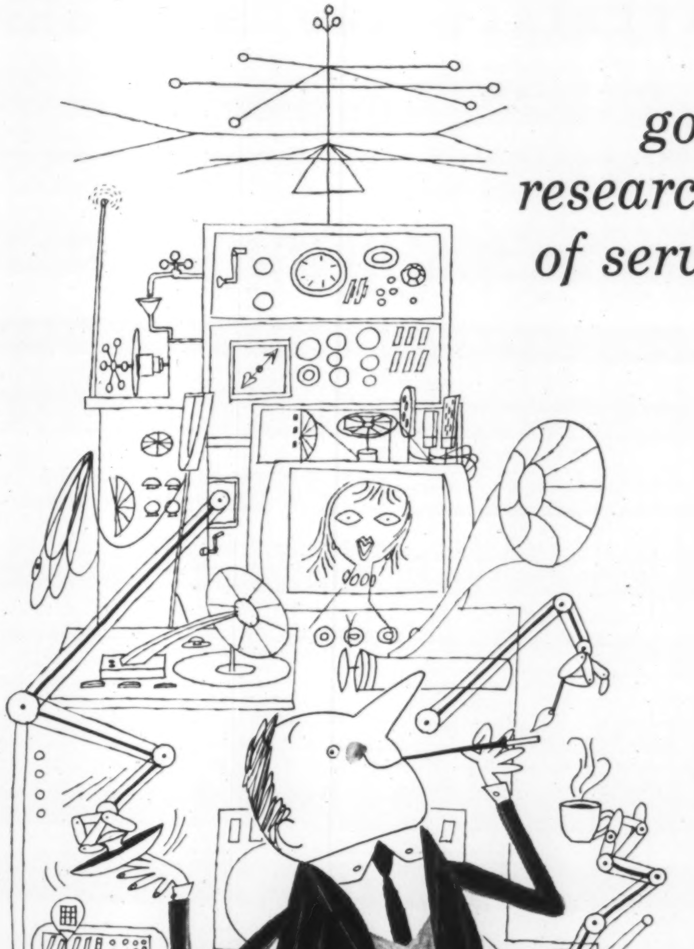
The manufacture of a Backhoe designed for use with the new Models HH and HU, 4-wheel drive "Payloader" tractor-shovels, has recently been announced.

The ¼-yd capacity Backhoe is a completely independent unit and replaces the "Payloader" bucket quickly and easily by attaching it to the boom arm by only two pins and the hydraulic hose connections.

Independent Unit

The hoe digs and dumps at a radius of 190-deg, enabling it to work in congested areas ordinarily inaccessible to units of this type. With a digging reach of 12-ft 4-in., the unit will reach to a depth of over 13-ft and load to a height of better than 9-ft.

Powerful down pressure and breakout force are provided by twin boom cylinders. High speeds on retraction of the dipper stick completes its faster operating cycle. The rubber tires of the Payloader units enable rapid travel from one job site to another, regardless of the terrain. **Wain-Roy Corp., CE 2-122, Hubbardston, Mass.**



How to make the most
of your engineering career
ONE OF A SERIES

go where research gives you plenty of service

Many things can help—or hinder—your progress in engineering. One such is the kind of research available in the company you join.

This, by no coincidence at all, is another area in which Boeing can be of real help to you. Boeing backs its engineers with one of the most extensive arrays of research laboratories in the industry. In addition, electronic computing and data processing equipment gets you the answers you want—fast. So do such facilities as the huge Boeing Flight Test Center. And the Boeing wind tunnel, most complete and versatile privately owned tunnel in America. This outstanding facility, capable of velocities up to Mach 4, is at the full-time disposal of Boeing engineers. It has enabled Boeing to gain more wind tunnel time in the field of jet aircraft than *any* other company.

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At Boeing you'd enjoy many other advantages; a high starting salary, career stability, a liberal retirement plan and company-paid graduate study programs. There are *family* advantages too; a choice of three sections of the country, each with excellent housing and schools, shopping centers and abundant recreation facilities for the whole family!

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Mail this coupon to the address above from which you desire further information about the advantages of a career with Boeing.

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EQUIPMENT, MATERIALS and METHODS

(continued)

Unique Elevator

A COMPLETELY NEW CONCEPT in construction and industrial personnel elevators has been introduced. This unique elevator, operating on a vertical monorail, has a 2,000-lb capacity. The first and only type of demountable, approved passenger elevator, it takes the place of a permanent elevator installation. Simple to set up and operate, it can be quickly disassembled and moved to another location and re-erected in a short time and because the Hawkeye elevator is so easy to move and rig, it finds practical application in large industrial plants as a semi-permanent personnel and materials handling unit which can be mounted outside of a building.

A double-grooved pulley on top of the monorail column smoothly carries the two steel hoisting cables as they lift the elevator car. A cable equalizer maintains equal tension on the two hoisting cables and trips a safety locking device should either cable stretch abnormally or break. The safety locking device, a positive cam-action brake, stops the elevator within ¼-in., and holds it there even while fully loaded. **Hawkeye Products Corp., CE 2-124, Syracuse, N. Y.**

Heavy-Duty Backhoe

IN ORDER TO PROVIDE a digging unit which would possess great over-the-road mobility and yet have ability to operate in rough terrain, this manufacturer has made available a truck mounted digging unit. The truck is a heavy-duty, 4-wheel drive.

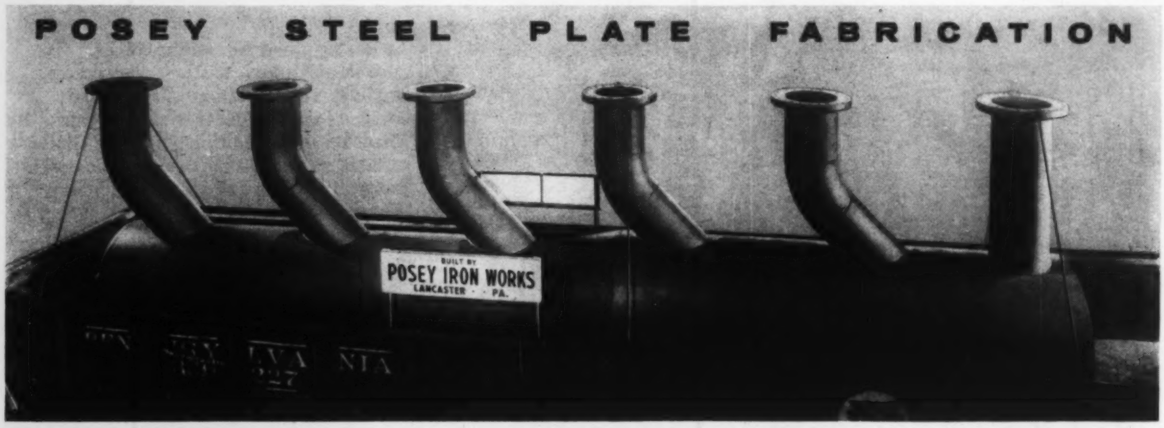
The trucks are renovated standard models with power take-off at the transmission for driving the hydraulic system of the backhoe. Standard mounting on the truck frame is adaptable to either the Chief or the Warrior backhoes. The Chief digs approximately 15-ft deep and the Warrior approximately 12-ft deep. Both backhoes are designed on the push-pull principle, with hydraulic cylinders synchronously but in reverse directions on either side of the axis pin. Also, both models operate in three 120-deg quadrants which are changeable easily by the operator without leaving his position at the controls.

Because of the 4-wheel drive and the individually controlled hydraulic stabilizers on the backhoe, the unit can literally go anywhere and dig anywhere. **Shawnee Manufacturing Company, CE 2-124, North Topeka Avenue, Topeka, Kansas.**

Durolite Blocks and Sheaves

DUROLITE BLOCKS ARE NOW available for any job or machine where a top quality block is required. These blocks are used on all Sauerman DragScraper Machines and Cableways for easier handling and to reduce wear on the running ropes. The blocks feature end thrust bearings to prevent side frame wear, free-moving swivels for easy positioning and a cast bead on the side frames prevents fouling of the wire rope. They are available from stock in sizes from 6-in. to 18-in. with bronze bearings and from 8-in. to 42-in. in roller bearings. Sizes up to 54-in. or specials can be furnished to specification.

Durolite Sheaves are lighter in weight than other sheaves of the same rated capacity but provide high structural strength and durability for handling heavy loads at high speeds. They start instantly and stop without spinning. The sheaves are available in stock sizes from 6-in. to 18-in. (alloy steel) and 20-in. to 24-in. (cast steel). **Sauerman Bros., Inc., CE 2-124, 610 S. 28th Avenue, Bellwood, Ill.**



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To avoid duplication of effort and to bring the hydraulics engineer a definitive list of available translations of literature on hydraulics, the Committee on Research of the Hydraulics Division has prepared "A List of Translations of Foreign Literature on Hydraulics." This material is available as ASCE Manual 35—the latest of a renowned series of authoritative publications on civil-engineering subjects. This Manual can be ordered by clipping this coupon and remitting as indicated below.

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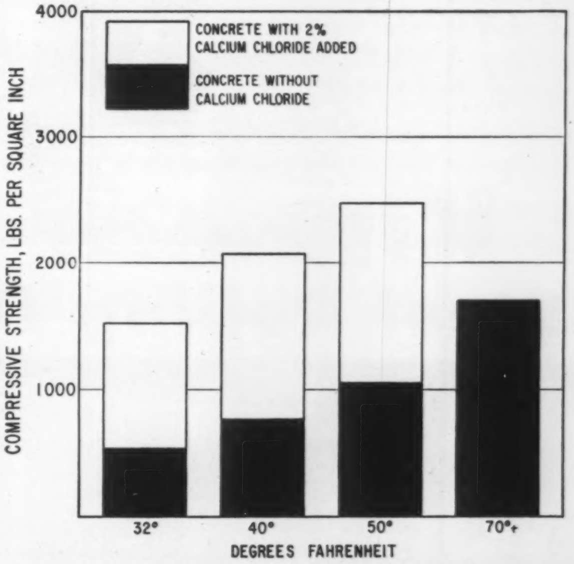

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†Ideal curing temperature
*From Highway Research Board Proceedings 1941–45

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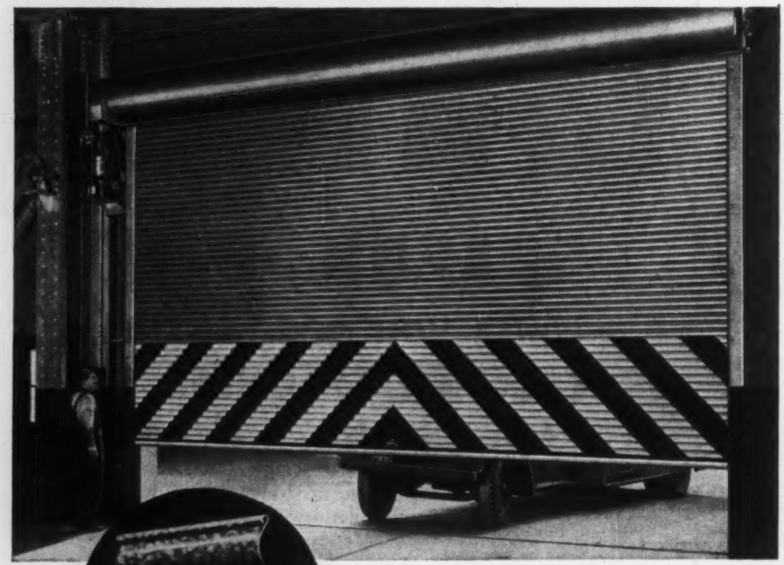

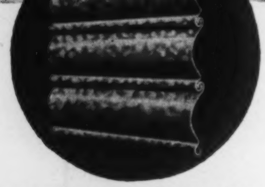

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EQUIPMENT MATERIALS and METHODS

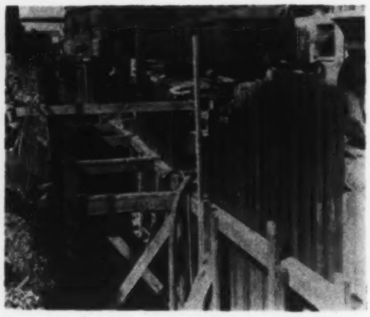
(continued)

Steel Sheet Piling

LIGHTWEIGHT STEEL SHEET piling was reused ten to twenty times on a sewer project by a Wisconsin Company. Using its own construction crews, the company installed 450-ft of concrete, tile-lined sewer pipe to drain industrial acids from its bleach plant. Pipe was laid at an average depth of about 8-ft.

To support trench sides after excavation they used about 800-lin ft of lightweight steel sheet piling. Using an Ingersoll-Rand PB8A pile driver, the piling was driven 10 to 12-ft to refusal in a layer of decomposed granite lying about 2-ft above bedrock.

According to company officials the lightweight piling was selected for 3 reasons; its cost advantage over regular sheet piling, its easier handling characteristics, and its easier driving characteristics. **L. B. Foster Company, CE 2-126, Noblestown Road, Pittsburgh 30, Pa.**



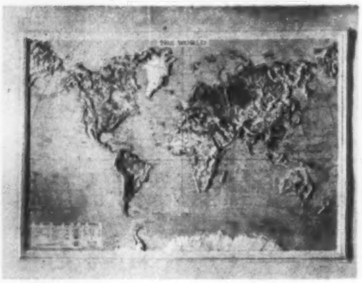
Reusable

Adjustable Height Tripod

A PORTABLE TRIPOD, with telescopic legs to meet any setup requirement, is announced. Maximum height is 14-ft, yet adjustment to settings under 8-ft is possible. This eases handling and allows the tripod to be carried in a small panel truck or even a station wagon. The legs can be individually compensated for setups on ramps, truck beds, platforms, and rough ground, which saves cutting off one leg and the cost of rebuilding at a later date. Thus one unit gives correct setups at all jobs. The weight is only 80-lbs, complete, with a capacity of 1½-tons. The height adjusting bolts are self-locking, freeing both hands for setting the legs. Footing is secure on concrete, asphalt, wood block or soil. Pads are available to protect polished floors. A special attachment converts two legs into a very fine A-frame. **B. E. Wallace Products Co., CE 2-126, Exton 20, Pa.**

EQUIPMENT, MATERIALS and METHODS

(continued)



Relief Map

A NEW RELIEF MAP of the world has been published by a world-wide mapping company. Formed of rigid vinyl plastic, the three dimensional map is 64 x 41 in. It is printed in 10 rich colors, representing land elevations and ocean depths. Nearly 3,000 place names are shown on the new map. This detailed coverage includes 2,000 cities and towns —450 bodies of water—700 islands, capes and mountains. International airports, railroads and boundaries are also shown, along with time zones.

The map depicts islands of the Far North in true position, reflecting recent mapping studies there. Little known Antarctic areas and stations of the International Geophysical Year there are also shown. In the past some islands have been out of position by as much as 60 miles. The projection used is the Van der Grinten projection, and the map scale at the equator is 1-in. equals 434-miles. Vertical exaggeration, common to all relief maps to emphasize relief character, is 50 to 1.

The surface of the map is plastic coated to protect the colors and assure easy cleaning. A damp cloth wipes dust or fingerprints from the map. Other relief maps produced include Canada, the United States, Europe, and several States. **Aero Service Corporation, CE 2-127, 210 E. Courtland St., Philadelphia 20, Pa.**

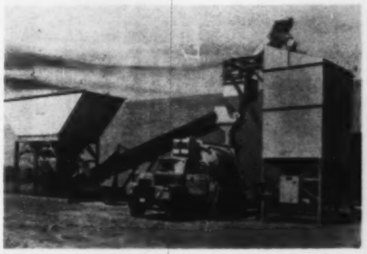
Portable Batching Plant

A PORTABLE CONCRETE batching plant with the capacity and accuracy of a permanent plant has been developed. It is the largest plant of its kind in use anywhere. Because no field wiring or plumbing is necessary and there are no pits to dig, the Porto-Plant, as it is descriptively designated, can be in operation within hours after its arrival on location delivering more than 100-cu yd per hour. All that is required is a source of water and power.

Physical components of the plant include; a hinged aggregate bin complete with batchers and scales in position for over-the-road hauling, portable belt conveyor on wheels, and portable Burmeister WeighMeister batching unit.

Important to contractors is the low initial cost, low installation expense, close proximity of the concrete supply, and the availability of exactly correct mixes through electronic control. The Porto-Plant can follow the job rather than have the ready-mix trucks traverse increasing needless miles from a permanent plant to the job site.

The entire unit when set up requires the attention of only one man who, through a centrally located electrical panel, operates every action with push buttons. **L. Burmeister Co., CE 2-127, Milwaukee, Wis.**



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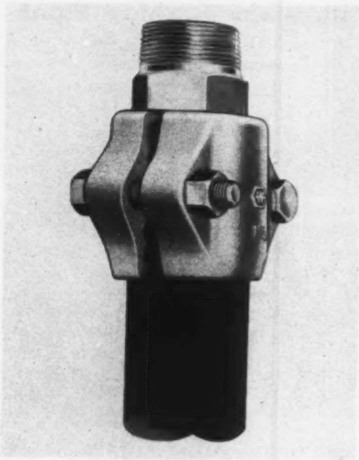
EQUIPMENT MATERIALS and METHODS

(continued)

New Clamp-Type Hose End

A NEW CLAMP-TYPE hose end which provides maximum versatility in high-pressure lines for air, hydraulic fluids, is announced. This couples readily on other types of hose and meets practically any original equipment of field replacement hose-end need. It is easily installed, requiring no hose skiving or special tools. Made of malleable iron, this new clamp-type hose end assures free flow and positive, long-lasting seal. Sizes are available from ¼ in. through 2-in.



Easily Installed

Special features consist of; cadmium-plated to resist corrosion, clamp valves, size for size, match perfectly; bolt holes assure constant center distances for true lineup of holes; bolt-head hex-shaped recess eliminates need for two wrenches; hose insert prevents restriction of hose I.D.; clamp retainer assures positive grip; all sharp edges are eliminated; bolts are of high-tensile steel. **The Weatherhead Co., CE 2-128, Fort Wayne Division, Fort Wayne, Indiana.**

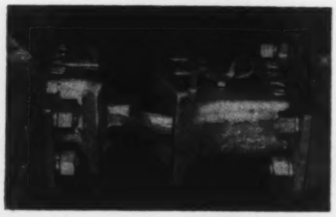
Four-In-One Attachment

THE ENTIRE LINE OF four-wheel drive Payloader tractor-shovels will now offer Drott 4-in-1 buckets as optional equipment.

This multi-purpose attachment has previously been available only on International Harvester crawler models. In the rubber-tired front-end loader field, it will be an exclusive offering on the Payloader line.

(*Continued on page 129*)

NEW, SAFE AND AUTOMATIC



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EQUIPMENT MATERIALS and METHODS

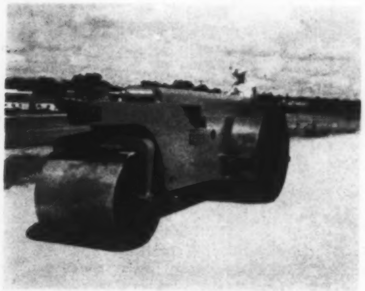
(continued)

The identification 4-in-1 comes from the fact that this attachment can be used: as a shovel—a conventional tractor-shovel bucket, used to dig, carry and dump in the regular manner; as a clamshell—the powerful clamshell action can be used to clean up small piles, to pick up material without tractor travel or to grasp and handle stumps, pipe, timbers and the like; as a scraper—becomes a carryall scraper that heap-loads itself, carries and spreads thin layers or dumps completely, strips sod and grades accurately; as a bulldozer—with hydraulic fingertip blade-pitch control to regulate dozing depth and to discharge sticky material.

The Drott 4-in-1 will be available for the models HU, HH and HO. **Frank G. Hough Co., CE 2-128 and 129, 938 Seventh Street, Libertyville, Ill.**

Reverse-O-Matic

A 12-TON INGRAM ROLLER, equipped with a new Reverse-O-Matic power concept drive permits no-stop power-shifted reversing with just one lever controlling both the speed and the direction of the roller. With Reverse-O-Matic, the roller can be shifted into reverse while moving forward, with no delay for stopping, clutching, or shifting gears.



The Reverse-O-Matic is a completely sealed-in-oil unit which requires no maintenance and no adjustments, and there are no clutches to replace. It furnishes smooth shockless power which reduces engine wear and prolongs the life of the other power transferring mechanisms.

The manufacturer claims that this new drive will prove to be a boon to road construction because the smooth reversing it furnishes is especially suited to asphalt and all other surfaces, and makes the Ingram roller one of the most practical, both for maintenance and operation, in use today. **Acme Iron Works, CE 2-129, San Antonio, Texas.**

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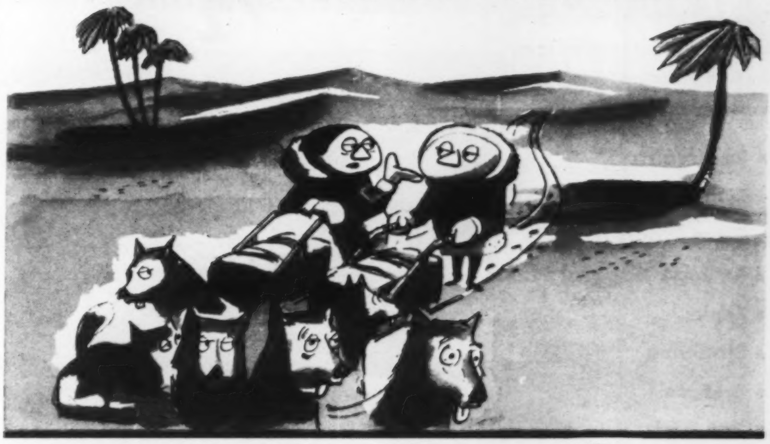

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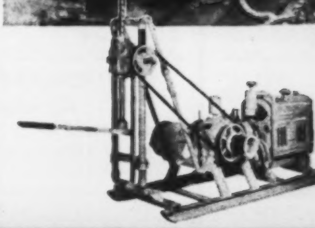
The Acker Model SK rotary drill head when combined with Acker RGT and RG rigs make an ideal unit for rock coring and foundation test boring. For complete information, write today for bulletin 28-CE.



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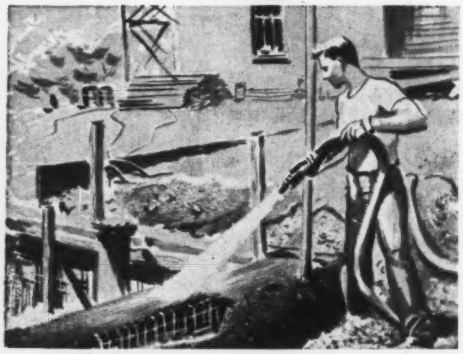

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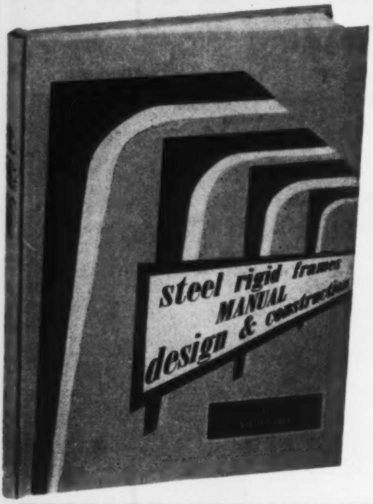

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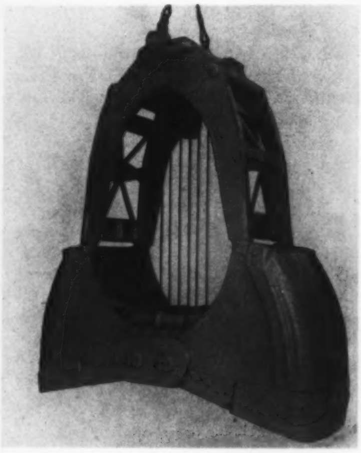
EQUIPMENT MATERIALS and METHODS

(continued)

Link-Type Alignment Device

THE JAMMING AND BREAKAGE of gear-type alignment devices, common with grab buckets handling noncrushable materials, is entirely eliminated by the new link-type hinge alignment device. The device has been specially developed for use on buckets handling slag, ore, and other extremely hard materials. In addition, the unit has a great deal more bearing surface than an ordinary gear-tooth engagement and is entirely enclosed, reducing wear and lubrication problems, and decreasing maintenance.



Carilloy T-1 Steel

The new link-type hinge alignment device, available only on Mead-Morrison buckets, is fabricated entirely of Carilloy T-1 steel which has extremely high tensile strength and is unaffected by exposure to the high heats involved in handling hot slag. Operation is by the interaction of a linkage of T-1 steel plates that replaces entirely the gear-teeth of conventional hinge alignment devices. **Mead-Morrison Division, CE 2-130, McKiernan-Terry Corporation, Harrison, N. J.**

Dredge Pump

MANUFACTURERS OF SAND, slurry and dredge pumps, have announced the completion of a new diesel engine powered heavy duty dredge pump combination. It is the largest dredge pump of its kind manufactured in the City of San Francisco, and is the only full lined dredge pump built on the West Coast. The pump and engines are assembled on a unit type base for rigidity and portability.

(Continued on page 131)

STEEL PLATE FABRICATION

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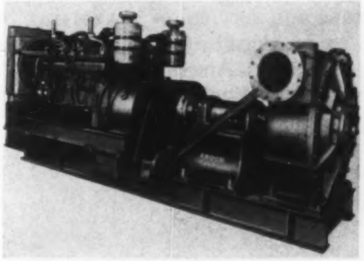
EQUIPMENT MATERIALS and METHODS

(continued)

The heart of the dredge consists of a new 12-in. full lined heavy duty dredge pump, which is designed to handle more than 5000-gal per min of sand, mud, gravel and water. It will pump to a distance of over half a mile or more under special operating conditions.

Equipped with hardened replaceable metal liners made of Ni-hard, or nickel iron designed for this rough service, the pump is built upon an integral base, and is powered with Twin International Harvester diesel engines, Model UD-1091, mounted on a Alamo Compound series 450 reduction unit, equipped with a Twin disc over center clutches. The radiators are specially manufactured for these engines by the Perfex Radiator Company. The UD-1091 diesel engines are the largest made at present by the Construction Equipment Division of the International Harvester Company. This twin engine combination is rated at 380-hp naturally aspirated and 500-hp Turbo-charged. **Krough Pump & Equipment Co., CE 2-130 and 131, 515 Harrison Street, San Francisco, Calif.**



Diesel Powered

Tamper

The Jay Tamper Model 12 took three years of research and testing to perfect. The machine combines Vibration plus Impact blows to properly keyseat and tamp material to high uniform procter densities.

Though it weighs only 240-lb, this machine will deliver more pressure per square inch than a ten-ton roller but is small enough to be carried by two men. Extremely versatile, the Jay Tamper features interchangeable tamping shoes in three sizes, 12-in., 18-in., and 24-in. It is equally at home in ditches, on roadbeds, flush against walls, inside buildings, around pilings or tamping the foundation for a bridge approach.

Entirely self-contained, it needs no expensive auxiliary equipment and can operate a full eight hours on two gallons of gasoline. **The Jay Company, CE 2-131, 168 Hosack Street, Columbus, Ohio.**

SURVEYING NEWS

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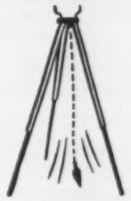

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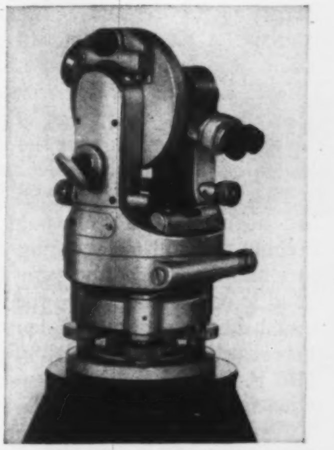

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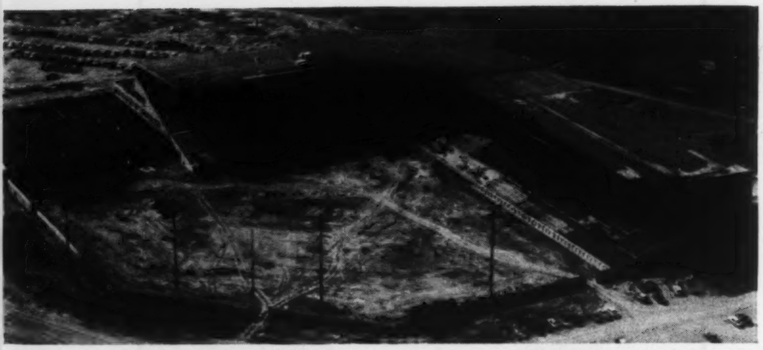


New Joint Sealing Compound "Stays Put"

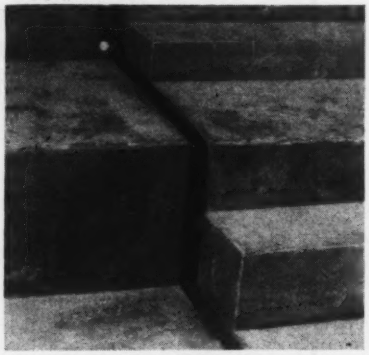
. . . keeps stadium joints sealed permanently

Determined to insure that concrete joints in the new Kentucky Fair Exposition Center and Stadium at Louisville, Kentucky would stay sealed under all conditions, Fred Elswick & Associates, Louisville, Ky. architects and engineers, set up stringent specifications for the joint sealing compound.

They called for a material that had no cold flow, that would not become soft and tacky during summer months, and at the same time bond to concrete and keep the joint sealed during extremes of temperature ranging from −10° F. to 110° F. Ease of installation was another important factor.

"VERTISEAL"—a new cold-applied, self-vulcanizing joint sealing compound manufactured by Servicised Products Corporation, Chicago, was selected for the job because it met and even exceeded the specifications set up. Tests indicated that "VERTISEAL" had great tensile strength, highly favorable elongation and penetration characteristics plus the desired absence of cold flow after cure.

Installation of the "VERTISEAL" was done by General Insulating & Roofing, Inc. of Louisville. "VERTISEAL" is a two-component material and correct quantities of both components are shipped in a single one gallon container. After mechanically mixing the components, the material was ready for installation. Caulking guns were used to apply the material to vertical joints in the stadium's risers. A pouring grade of "VERTISEAL" was mixed in the same manner and simply poured into the horizontal joints from suitable containers. J. O. Durham, Superintendent of General Insulating states: "VERTISEAL" was very satisfactory in every respect. We had no trouble in mixing or installation. Our men were able to seal vertical and horizontal joints with equal ease." Technical assistance and service on "VERTISEAL" were provided by the Manufacturers Distributor, American Builders & Supply, Louisville.



24 to 48 hours after installation, the "VERTISEAL" set up into a tough, resilient, self-vulcanizing cured rubber seal which "stayed put" and required no touch-up or further attention. "VERTISEAL" is available in either black or white, and in two consistencies—troweling and gun grade for vertical or sloping joints and pouring grade for horizontal joints. Because it is equally effective and maintains excellent bond with concrete, metal, glass or any combination of these, it is widely used as a caulking compound. Typical applications include architectural expansion joints above grade, exterior glass with metal frames, sealing panels in metal-clad structures, masonry coping, swimming pools, etc. A special "VERTISEAL" brochure is available on request from the manufacturer.

SERVICISED PRODUCTS CORPORATION
6051 WEST 65th STREET, CHICAGO 38, ILLINOIS

EQUIPMENT MATERIALS and METHODS

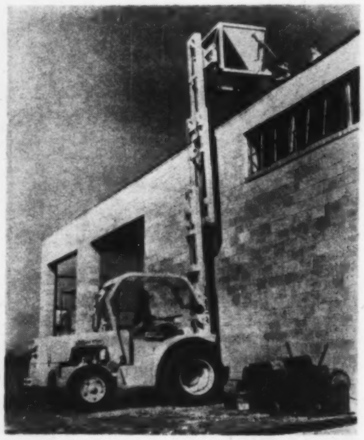
(continued)

Tracto-Lift

A NEW MODEL TRACTO-LIFT with 21-ft lift, which operates efficiently over rough terrain not accessible to conventional fork trucks, has been announced.

The 21-ft lift model has been designed for placing palletized masonry materials on high scaffolds and hoisting roofing material to the roofs of one story buildings. The speedy lateral movement of building materials reduces construction costs. A special concrete bucket is available for handling ready-mix concrete, mortar, and granular materials used in the building industry. Light steel erection can be accomplished with a boom attachment which is also available.

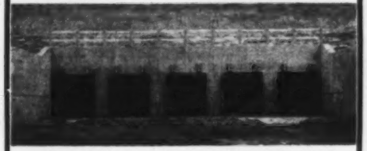
The high lift model includes many features as standard equipment, such as a sturdy overhead guard, shuttle transmission (providing 6 speeds forward and 6 speeds reverse), power steering, and hour meter.



21-ft Lift

The large diameter front wheels are equipped with 14.00 x 24 tires, and set at wide tread for excellent traction and flotation over the rough terrain normally associated with the construction industry. Large diameter rear wheels with 8.25 x 16 tires, coupled with power steering, provide easy steering and smooth operation in unpaved areas. The Tracto-Lift is also available in three standard models, the TL-50, TL-60 and TL-70. **Ottawa Steel Division, CE 2-132, L. A. Young Spring & Wire Corp., Ottawa, Kansas.**

TIDE GATES



FIVE 96" x 96" TYPE M-M-T TIDE GATES INSTALLED NEAR WILKES-BARRE, PA.

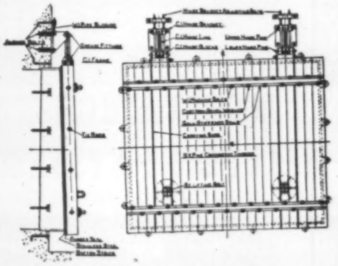


FIG. 9320 SHOWING TYPICAL CONSTRUCTION.

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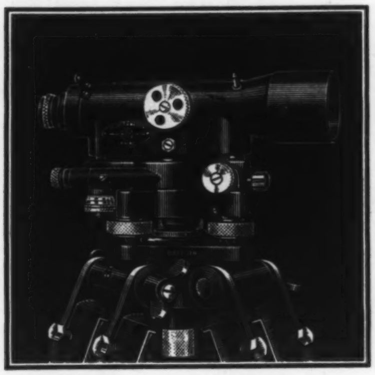

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Literature Available

LORAIN "50"—A new 2 color catalog describing the many new features incorporated in the fully air-controlled, crawler mounted Lorain "50" is now available. Chief among these features are the 2-lever, "joy stick" controls for all turntable operations. Metered "Aire-Ease" operation feeds air power to clutches at any rate desired and retains full feel of all operations. **Thew Shovel Company, CE 2-133, Lorain, Ohio.**

LOWER POWER COSTS—How to obtain better power economy through the use of spark ignition engines is the topic of Lower Power Costs, an 8-page booklet recently published. The booklet takes a practical look at the recently-introduced spark ignition engines, in determining which owners can best profit by its use. Contained in the brochure is a step-by-step explanation of how engine users can determine if spark ignition engines will be most economical in their territory and on their application. **Caterpillar Tractor Co., CE 2-133, Peoria, Ill.**

TRENCHLINER—Featuring a 25 per cent increase in digging capacity, publication of a new catalog describing the improved Model 155 Trenchliner has been announced. Photographs and drawings are incorporated in the attractive 16-page catalog to describe principal construction and application features of the 155 Trenchliner in general utility work. The compactness of this Trenchliner allows it to operate in congested areas that normally are inaccessible to trenchers of comparable capacity. **Koehring Company, CE 2-133, Milwaukee, Wisc.**

CONSTRUCTION HANDBOOK—Architects' and engineers' use of many scattered fragmentary sources of timber design data has been eliminated by the new 622-page book, "Timber Design and Construction Handbook", according to Timber Engineering Company, research affiliate of National Lumber Manufacturers Association and longtime clearing house for wood construction data and designs. The new book is the first complete master compilation of technical data on designing and building in timber, and contains all the essential basic information needed to develop the best and most economical structures in wood. Produced for the convenience of architects, engineers, and other designers, as well as for instructiors and students of these professions, the Timber handbook is a combination design reference, field manual, and textbook. Price $12.75. **Timber Engineering Company, CE 2-133, 1319 Eighteenth Street, N.W., Washington, D. C.**

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NEW PRODUCTION AREA: Standard Steel Corp., Los Angeles has purchased the Leader Iron Works, Decatur, Ill. Road-Master asphalt paving plants will be an important product of this new midwest facility which will provide a production and distribution point near the center of the anticipated highway construction . . . **WATER CONDITIONING DEVICE:** A major advance in industry's constant war on scale and corrosion in water piping and equipment, which annually costs millions for replacement and repair, was announced today by Packard Water Conditioner Div., Inc., Jacksonville, Fla. after three years of market-testing a new water conditioning device . . . **NEW HIGH IN NET OPERATING INCOME:** Merritt-Chapman & Scott's net operating income of $9,793,000 for the first three quarters marked a new high, representing a 42% gain over the same period last year . . . **PRICE INCREASES:** Prices on several of its product lines have been increased 5 to 10%, General Electric's Metallurgical Products Dept. reported recently. These increases reflect rising costs of labor and materials . . . **HIGH SPEED PROJECT:** In a demonstration by Ellbel Construction Co. in the application of modern machinery to speed up home building, even helicopters were used to fly furniture to the site where a house was built from the foundation up and completely furnished. Maximum use was made of power tools of all types with Kohler Co., Kohler, Wis. supplying several electric plants . . . **CONTRACT AWARDS DECREASE 8%:** According to F. W. Dodge Corp., construction news and marketing specialists, moderate declines in non-residential building and heavy engineering contract volume reflect continuing tightness in capital funds rather than any diminution of potential demands . . . **RESEARCH AND TESTING:** The facilities of the Factory Mutual Laboratories are now being made available on a contract basis to organizations seeking help in product development or other research . . . **ATOMIC REACTOR:** Two U. S. firms have been selected to design, manufacture and furnish consulting engineering services for Venezuela's first atomic reactor at IVNIC, Caracas. The General Electric Co., Schenectady, N. Y. will design and manufacture the research reactor while the General Nuclear Eng. Corp., Dunedin, Fla., will act as consulting engineers . . . **NEW OFFICES:** National Pool Equipment Co., formerly of Birmingham, Ala., has opened new offices at Lee Highway, Florence, Ala. . . . **APPOINTMENTS:** John E. Heald, who has represented the Construction Materials Div., John A. Roebling's Sons Corp. in the South-East area has been assigned to the Mid-West territory.

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PROCEEDINGS AVAILABLE

For instructions and key to abbreviations, see next page. Each member is entitled to 100 different "Proceedings Papers" yearly, ordered from these pages, plus all papers of the Technical Divisions in which he registers. The latter papers will be mailed automatically. Discussion of a paper will be received during the four full months following the month of issue.

January

1136. Population Estimates for the State of Oregon, by George W. Reid. (CP) Population estimates for Oklahoma for the years 2000 and 2050 are based on the premise that United States population will grow following theoretical patterns and that this growth will cause migration to less populated areas. These estimates are presented as a guide to future development of Oklahoma with emphasis on water-resource development.

1137. The City Planner in Pittsburgh's Renewal Projects, by Patrick J. Cusick, Jr. (CP) This paper describes extensive contributions that have been made toward rebuilding blighted urban areas under redevelopment powers. Substantially expanded activities in this field are a result of introducing the renewal concept in the Federal Housing Act of 1954.

1138. The Boundary Layer Development in Open Channels, by J. W. Delleur. (EM) Development of a turbulent boundary layer is analyzed theoretically for the case of a steady flow in a horizontal open channel. The problem is solved for a rectangular cross section. A simplified solution is given for a channel of larger width, and the theory is compared with experimental results.

1139. Approximation to Plastic Behavior of Circular Membranes, by N. A. Weil. (EM) An approximate theory is presented for plastic behavior of clamped, circular membranes subjected to lateral hydrostatic pressures. The von Mises-Hencky relationships are taken to govern the plastic behavior of the material; suitable approximations are adopted for the biaxial stress-strain and strain-displacement laws.

1140. Lateral Buckling of Plane Frameworks, by E. F. Masur and A. Cukurs. (EM) The stability of trusses against buckling perpendicular to their plane is analyzed. Following derivation of basic relationships, a "series criterion" of stability is established. It is demonstrated that the customary method of equalizing the slenderness ratios of compression members in both directions may lead to unbalanced design.

1141. Wind Induced Vibration of Cylindrical Structures, by Joseph Penzien. (EM) This paper presents the results of an investigation to determine the dynamic behavior of cylindrical sections under the action of wind at high Reynolds numbers. These results show that wind-induced vibration normal to the direction of wind is "self excited" rather than "forced." Two critical wind velocities were observed.

1142. Laboratory and In-Situ Permeability of Sand, by Charles I. Mansur. (SM) Seepage analyses and design of seepage-control measures require accurate knowledge of the permeability coefficient of the sand strata involved. Results of laboratory tests on remolded sand samples are compared with permeabilities obtained from field pumping tests.

1143. Seepage Through Foundations Containing Discontinuities, by Elbert E. Esmiol. (SM) Four case histories show that earth dam foundation materials may be disrupted by discontinuities. These depositional, erosional, and structural forms complicate seepage control. Successful, rationally conceived, remedial measures for specific seepage problems are presented.

1144. Consideration of Pore Pressure in the Stabilization of an Ore Pile, by Karl Terzaghi and Ralph B. Peck. (SM) Instability of the track supporting one end of an ore bridge in a steel plant was caused by excess porewater pressure in a layer of silt. A succesful permanent system of vacuum well points was installed after preliminary field tests demonstrated the feasibility of draining the silt in this manner.

1145. General Aspects of Cement Grouting of Rock, by V. L. Minear. (SM) Past experience of cement grouting of rock foundations in the United States is reviewed. Pertinent items as to what constitutes the best practice in cement grouting, and their pros and cons, are presented. Examples are given of experience on construction projects and of current practices and techniques used in pressure grouting.

1146. Effects of Cambering of Steel WF Beams, by Harry H. Hill. (ST) Cambering steel beams is usual today in simple span bridges. Although residual stresses are disregarded by design procedure, they are of sufficient magnitude to be considered.

1147. A Circuit Analysis of Laterally Loaded Continuous Frames, by Frank Baron. (ST) A distribution procedure, complementary to moment distribution, is developed for structures lying in a plane and having curved or segmental members forming any number of multi-connected circuits in the plane. The procedure is based on the same geometrical requirements as in column analogy and shear and torsion analogy.

1148. Fatigue Tests of Riveted or Bolted Aluminum Alloy Joints, by M. Holt, I. D. Eaton, and R. B. Matthiesen. (ST) Fatigue test results for aluminum-alloy monobloc specimens, butt joints, and lap joint indicate that specimens with idle rivets have higher fatigue strengths than those with open holes; that symmetrical joints have higher fatigue strengths than unsymmetrical joints; and that joints with tightly drawn bolts or flush-head rivets have

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higher fatigue strengths than joints with protruding-head rivets.

1149. Shearing Strength of Reinforced Concrete Slabs, by Nan-Sze Sih. (ST) Based on a study of tests made by different investigators, the shearing strength of reinforced concrete slabs may be predicated by the criteria proposed in this paper. These criteria indicate that Talbot's method is applicable only within a limited range of the design.

1150. Behavior of Riveted Connections in Truss-Type Members, by E. Chesson, Jr., and W. H. Munse. (ST) The tests reported in this paper provide information on the general behavior of large truss-type riveted-steel connections; the test program includes specimen configuration, method of hole preparation, and size of rivets. A study is made of the comparative behavior of the specimens, the distribution of load to the gusset plates, the strains in the lacing bars, the effect of hole preparation, and the predicted and computed efficiencies of the connections.

1151. Choice of Composite Beams for Highway Bridges, by Harry Subkowsky. (ST) This paper presents a series of preliminary design charts for the rapid selection of rolled beams and cover plates used as stringers in simple-span composite highway bridges. A description of the charts, their uses, and the assumptions made in their development is given.

1152. Discussions of Proceedings Papers 509, 510, 710. (CP) No closure to 509. W. R. B. Froehlich closure to 510. No closure to 710.

1153. Sector Analysis for Concrete Pavement Load Stresses, by Bengt F. Friberg. (HW) Sector analysis is outlined, which is an approximation method of elastic analysis for slabs subjected to tire-imprint loads and resting on yielding subgrades and is used for loaded-area dimensions and for slabs of limited dimensions. Principles and procedures are described.

1154. Discussions of Proceedings Papers 797, 1031, 1032, 1073. (EM) Corrections to 797. W. M. Lansford and J. M. Robertson; C. J. Posey on 1031. R. V. Hauer, C. J. Posey, C. M. Segedin on 1032. R. L. Ketter on 1073.

1155. Discussions of Proceedings Papers 754, 842, 861, 866, 1025, 1026. (SM) No closure to 754. H. B. Seed and L. C. Reese closure to 842. A. R. Jumikis closure to 861. G. G. Meyerhof closure to 866. H. R. Cedergren; R. B. Peck and H. O. Ireland on 1025. E. J. Zegarra, R. L. McNeill on 1026.

1156. Discussions of Proceedings Papers 762, 851, 869, 915, 1019, 1020, 1022, 1054. (ST) No closure to 762. H. A. Sawyer, Jr., closure to 851. N. E. Landdeck closure to 869. E. L. McDowell, K. E. McKee, and E. Sevin closure to 915. G. S. Vincent, L. Balog, G. K. Gillan on 1019. J. Chinn on 1020. T. Au, H. S. Schick, Z. Sobotka, M. Spanovich, S. M. Ulicny on 1022. W. Lum on 1054.

1157. A Pressure Line Concept for Inelastic Deformations, by Frank Baron. (EM) The concept of the pressure line is developed for quickly estimating the effects of plasticity on the behavior of structural elements subjected to axial and flexural loads. An initial estimate, obtained by means of an elementary theory of mechanics, is adjusted to fit the conditions of plasticity.

1158. The Infinite Elastic Beam on a Linear Viscoelastic Foundation, by Alfred M. Freudenthal and Harold G. Lorsch. (EM) The infinite, elastic beam on three different types of linear viscoelastic foundations is analyzed under various loads. Initial, transient, and terminal states of beam deflection and foundation pressure are determined; numerical examples with graphs are given; and the extension of the results to finite beams is discussed.

1159. Moisture Conditions Under Flexible Airfield Pavements, by J. F. Redus. (SM) Investigation of moisture conditions under flexible airfield pavements over a period of years indicates that base course and subgrade moisture contents become stabilized after about two years. Moisture contents in the upper 18 in. were found to be unrelated to rainfall, but those at 30 in. appeared to be related to rainfall.

1160. Frictional Resistance of Steel H-Piling in Clay, by Eben Vey. (SM) A steel H-pile instrumented with strain gages was driven 50 ft through medium clay into hard soil and load tested. Results were found in good agreement with unconfined compression data provided the shear perimeter was taken as twice the distance between flanges.

1161. Relative Density and Shear Strength of Sands, by T. H. Wu. (SM) Relative density of natural sand deposits was investigated by tests on undisturbed specimens taken at regular intervals throughout the deposits. Results were correlated with the grain-size characteristics and with the penetration resistance. Triaxial tests were made to evaluate the influence of the relative density of the shear strength.

INSTRUCTIONS

1. Every ASCE member can be registered in two of the Technical Divisions and receive automatically all papers sponsored by those Divisions. **Such registration will be effective 30 days after the receipt of the registration form.**

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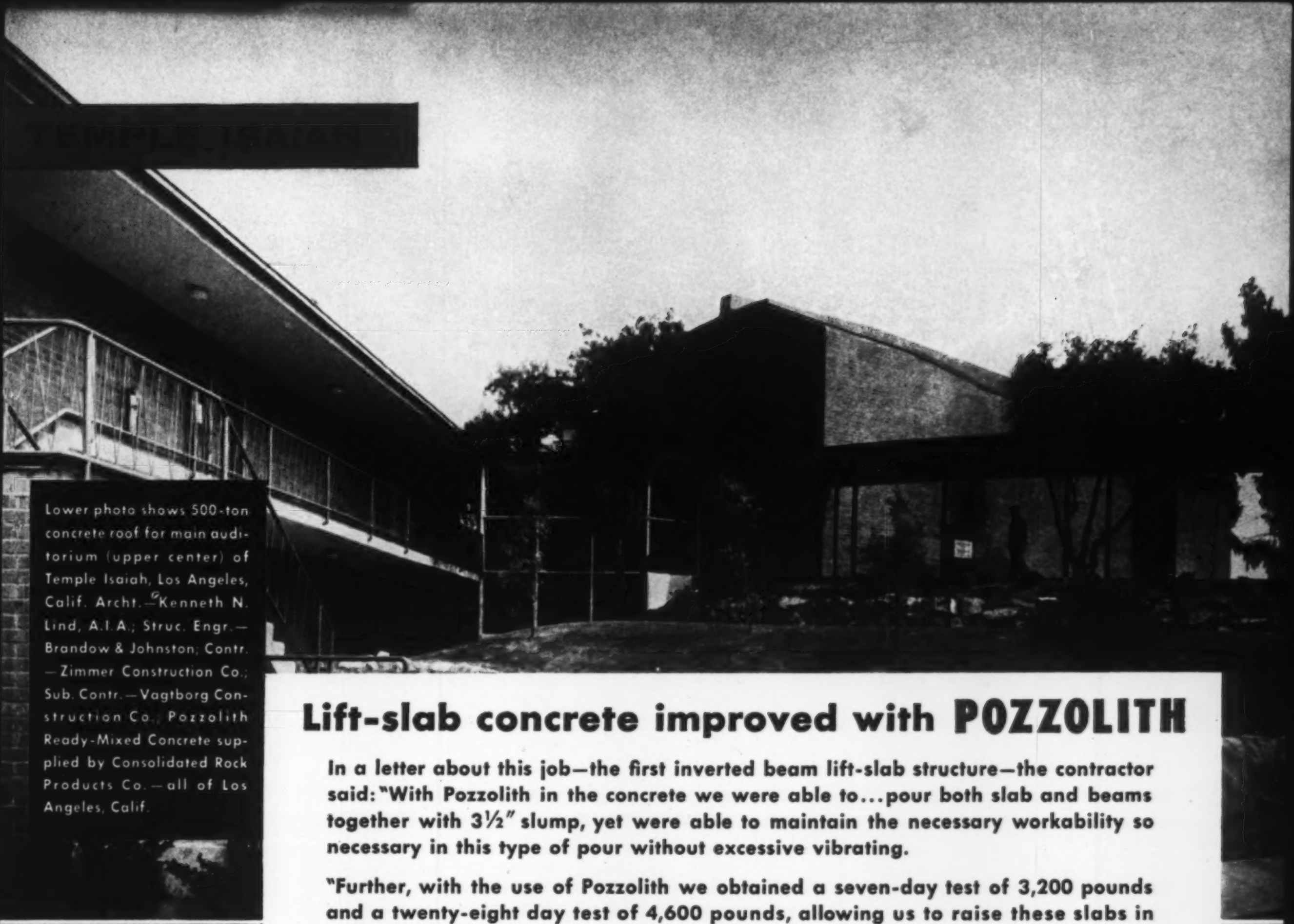

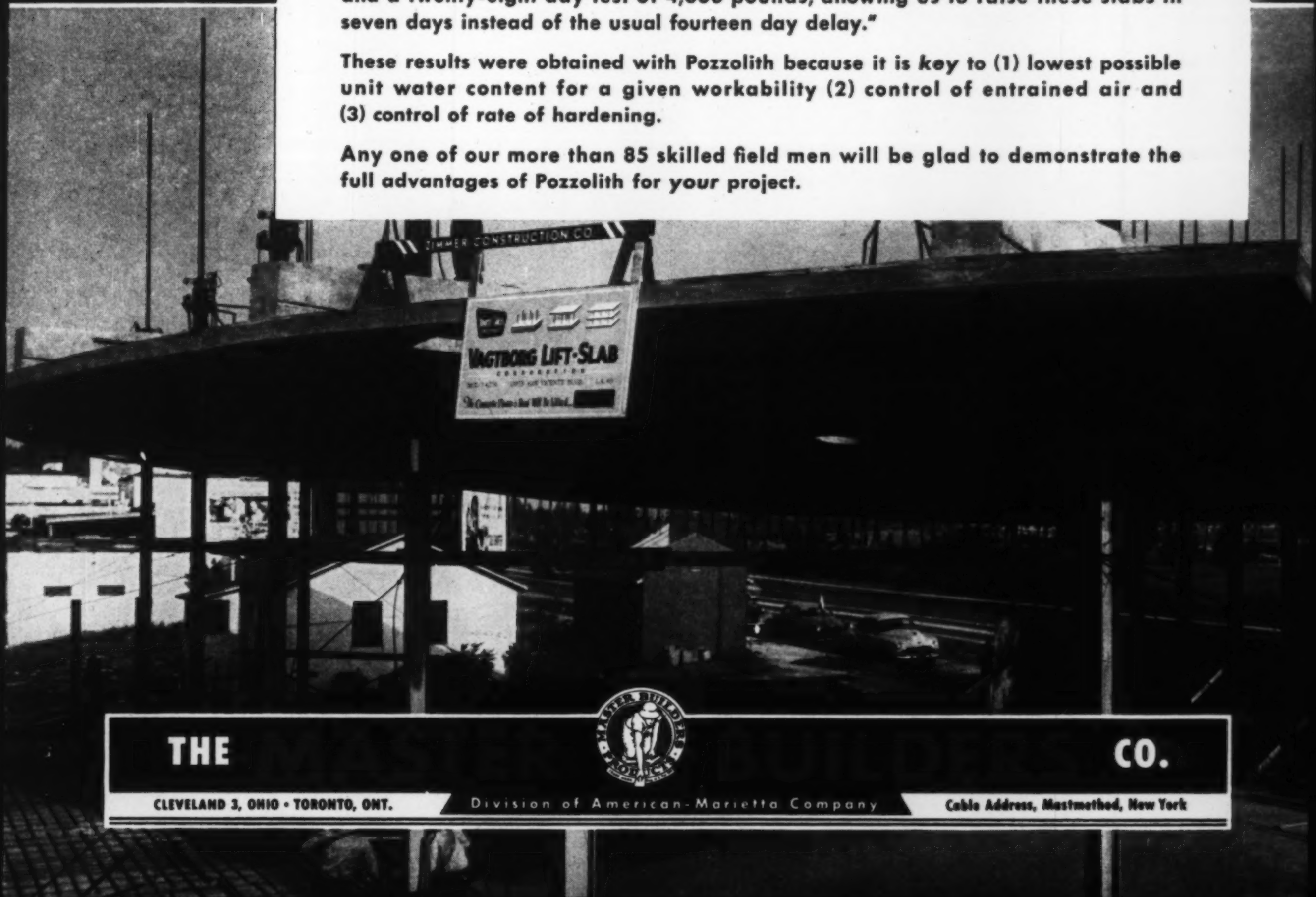

Lower photo shows 500-ton concrete roof for main auditorium (upper center) of Temple Isaiah, Los Angeles, Calif. Archt.—Kenneth N. Lind, A.I.A.; Struc. Engr.—Brandow & Johnston; Contr.—Zimmer Construction Co.; Sub. Contr.—Vagtborg Construction Co.; Pozzolith Ready-Mixed Concrete supplied by Consolidated Rock Products Co.—all of Los Angeles, Calif.

Lift-slab concrete improved with POZZOLITH

In a letter about this job—the first inverted beam lift-slab structure—the contractor said: "With Pozzolith in the concrete we were able to...pour both slab and beams together with 3½" slump, yet were able to maintain the necessary workability so necessary in this type of pour without excessive vibrating.

"Further, with the use of Pozzolith we obtained a seven-day test of 3,200 pounds and a twenty-eight day test of 4,600 pounds, allowing us to raise these slabs in seven days instead of the usual fourteen day delay."

These results were obtained with Pozzolith because it is *key* to (1) lowest possible unit water content for a given workability (2) control of entrained air and (3) control of rate of hardening.

Any one of our more than 85 skilled field men will be glad to demonstrate the full advantages of Pozzolith for *your* project.

THE MASTER BUILDERS CO.

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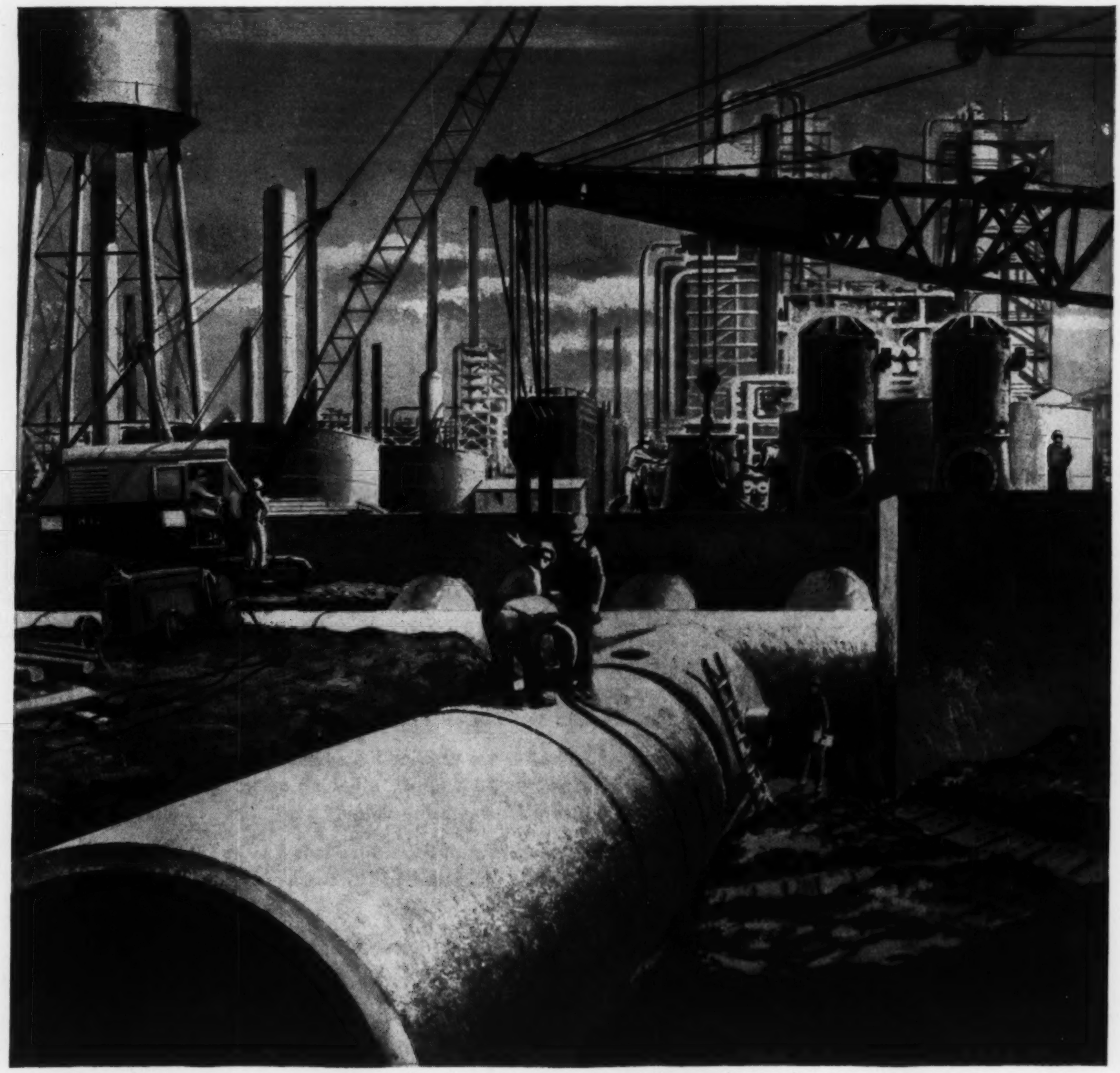

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Only the most rugged and dependable type of pipe could be trusted to handle such volumes of water within the limited confines of a multi-million dollar plant. Yet Tidewater authorities are confident of the durability and safety of the refinery's Lock Joint supply lines because these characteristics are built into every Lock Joint pressure pipe through conservative design, careful choice of materials and expert workmanship.

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